EXHIBIT 12

Final

Record of Decision for Parcel E

Hunters Point Naval Shipyard
San Francisco, California

December 2013

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Prepared under:
Naval Facilities Engineering Command
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Acronyms and Abbreviations

ARARs	applicable or relevant and appropriate requirements
ARIC	area requiring institutional controls
BERA	baseline ecological risk assessment
bgs	below ground surface
BRAC	Base Realignment and Closure
CCSF	City and County of San Francisco
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	chemicals of concern
COECs	chemicals of ecological concern
COPCs	chemicals of potential concern
COPECs	chemicals of potential ecological concern
^{137}Cs	cesium-137
CSM	conceptual site model
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DTSC	Department of Toxic Substances Control
EOS	Parcel E open space (reuse area)
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	Feasibility Study
HHRA	human health risk assessment
HI	hazard index
HPALs	Hunters Point ambient levels
HPNS	Hunters Point Naval Shipyard
HQ	hazard quotient
HRA	Historical Radiological Assessment
ICs	institutional controls
IR	Installation Restoration
LUC RD	land use control remedial design

Acronyms and Abbreviations *(continued)*

MNA	monitored natural attenuation
MOA	Memorandum of Agreement
msl	mean sea level
MU	multi-use (reuse area)
Navy	Department of the Navy
NAPL	nonaqueous-phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NRDL	Naval Radiological Defense Laboratory
OMP	Operations and Maintenance Plan
pCi/g	picocuries per gram
PCBs	polychlorinated biphenyls
^{226}Ra	radium-226
RACR	Remedial Action Completion Report
RAOs	remedial action objectives
RD	remedial design
RI	Remedial Investigation
RME	reasonable maximum exposure
RMP	risk management plan
ROCs	radionuclides of concern
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SFPUC	San Francisco Public Utilities Commission
SLERA	screening-level ecological risk assessment
SVE	soil vapor extraction
SVOCs	semivolatile organic compounds
TCE	trichloroethene
TPH	total petroleum hydrocarbons
Triple A	Triple A Machine Shop, Inc.
VOCs	volatile organic compounds
Water Board	San Francisco Bay Regional Water Quality Control Board
µg/L	micrograms per liter
§	Section

Section 1. Declaration

This Record of Decision (ROD) presents the selected remedy for Parcel E at Hunters Point Naval Shipyard (HPNS) in San Francisco, California. HPNS was placed on the National Priorities List (NPL) in 1989 (U.S. Environmental Protection Agency [EPA] ID: CA71170090087). The remedy was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 (Title 42 United States Code Section [§] 9601, et seq.); and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 Code of Federal Regulations Part 300). This decision is based on the Administrative Record Index for this site[1]. The Administrative Record Index is included in the electronic version of the ROD as Attachment 1. The Department of the Navy (Navy) and EPA jointly selected the remedy for Parcel E. The California Department of Toxic Substances Control (DTSC) and the San Francisco Bay Regional Water Quality Control Board (Water Board) concur on the remedy for Parcel E. The Navy provides funding for site cleanups at HPNS. The Federal Facility Agreement (FFA) for HPNS documents how the Navy intends to meet and implement CERCLA in partnership with EPA, DTSC, and the Water Board.

Parcel E is one of six parcels (Parcels A through F) originally designated for environmental restoration. In September 2004, the Navy divided Parcel E into two parcels (Parcels E and E-2) to facilitate CERCLA administrative closure of the Parcel E-2 Landfill and its adjacent areas[2]. In February 2013, the Navy further divided Parcel E into two parcels (Parcels E and UC-3) to facilitate CERCLA administrative closure of Crisp Road, which will serve as a future utility corridor, and the adjoining railroad right-of-way[3]. This ROD addresses only Parcel E.

Parcel E includes two future land use districts: the Shipyard South Multi-Use District and Shipyard Shoreline Open Space. The Shipyard South Multi-Use District will include athletic and recreational facilities, office and industrial spaces, mixed commercial areas, institutional use, and residential areas. The Shipyard Shoreline Open Space will include recreational areas and ancillary commercial use.

[1] **Bold blue text** identifies detailed site information available in the Administrative Record and listed in the References Table (Attachment 2). This ROD is also available on CD, whereby bold blue text serves as a hyperlink to reference information. The excerpts referenced by the hyperlinks are part of the ROD. The hyperlink will open a text box at the top of the screen. A blue box surrounds applicable information in the hyperlink. To the extent inconsistencies may exist between the referenced information attached to the ROD via hyperlinks and the information in the basic ROD itself, the language in the basic ROD controls.

[2] Discussions within this ROD (as well as the Revised RI Report, FS Report, and the radiological addendum to the FS Report) that reference documents published prior to September 2004 refer to the portion of Parcel E that excludes Parcel E-2.

[3] The division of Parcel E into Parcels E and UC-3 was documented in the Proposed Plan in February 2013. Discussions within this ROD that reference documents published prior to February 2013 refer to the portion of Parcel E that excludes Parcel UC-3.

Environmental investigations began at Parcel E in 1984. A Draft Final Remedial Investigation (RI) Report for Parcel E was completed in 1997. The Final Revised RI Report for Parcel E was completed in 2008. The Final Feasibility Study (FS) Report was completed in 2012. This ROD documents the final remedial action for Parcel E and does not include or affect any other sites at HPNS.

1.1. SELECTED REMEDY

The CERCLA remedial action selected in this ROD is necessary to protect the public health, welfare, or the environment from actual or potential releases of hazardous substances from Parcel E. The selected remedy for Parcel E addresses the following contaminated media:

- **Soil** – metals, pesticides, polychlorinated biphenyls (PCBs), dioxins/furans, semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), and volatile organic compounds (VOCs)
- **Soil Gas** – VOC contamination in soil and groundwater has also resulted in contamination of soil gas at several locations in Parcel E, including Building 406, where the most laterally extensive soil gas contamination is located
- **Shoreline sediment** (i.e., shallow sediment subject to erosion or deposition within the intertidal shoreline zone) – metals, pesticides, and PCBs
- **Groundwater** – metals, PCBs, TPH, and VOCs
- **Nonaqueous-phase liquid (NAPL)** – NAPL at the Former Oily Waste Ponds (referred to as Installation Restoration [IR] Site 03 [IR-03]) contains metals, PCBs, SVOCs, TPH, and VOCs that are a source to soil and groundwater contamination (radionuclides, although not attributed to the NAPL source, are potentially present in soil at IR-03)
- **Radiologically Impacted Media** – soil, shoreline sediment, and structures at various Parcel E locations (referred to as radiologically impacted sites) may contain radiological contamination, including IR-02 and IR-03, where the most laterally extensive radiological contamination is present (radiological contamination in groundwater, although not identified during previous investigations, is potentially present at IR-02 and IR-03)

The selected remedy consists of the following actions to address risks posed by contaminated media:

Soil, Soil Gas, and Shoreline Sediment

- Remove and dispose of contaminated soil in selected areas (referred to as Tier 1, Tier 2, and TPH locations[4]) that contain nonradioactive chemicals (including metals, PCBs, SVOCs, and TPH[5]) at concentrations exceeding risk-based levels, as well as separate and dispose of materials and soil with radiological contamination found in these areas

[4] Soil removal is proposed in selected areas where nonradioactive chemicals are present at concentrations that exceeded the remediation goals. Tier 1 locations contain COCs at concentrations greater than 10 times the remediation goals. Tier 2 locations contain COCs at concentrations greater than 5 times the remediation goals. TPH locations contain TPH (commingled with CERCLA-regulated chemicals) at concentrations exceeding the petroleum source criterion (3,500 mg/kg). Please see Section 2.5.3 of this ROD for further information.

[5] These chemical groups comprise the Tier 1, Tier 2, and TPH locations proposed for removal. Dioxins and furans are not included in this list because these chemicals are not found at concentrations greater than 5 times the remediation goals.

- Treat VOC contamination in soil and soil gas at Building 406 by using in-situ soil vapor extraction (SVE)
- Install durable covers (consisting of either asphalt or soil) throughout Parcel E to prevent exposure to remaining contaminants in soil (the soil cover at IR-03 and the northwest portion of IR-02 would also include a protective liner to minimize water seeping into contaminated soil)
- Remove and dispose of contaminated shoreline sediment and install shoreline protection consisting of natural materials (such as sand) and large rocks to prevent exposure to remaining contaminants in shoreline sediment (and to integrate with the durable covers at onshore areas)
- Monitor and maintain the different parts of the selected remedies to ensure they are working properly (also applies to actions for groundwater and NAPL at IR-03)
- Use institutional controls (ICs) to restrict specific land uses and activities on Parcel E (also applies to actions for groundwater and NAPL at IR-03)

Groundwater

- Treat VOC contamination in groundwater at inland plumes using injected biological nutrients (or potentially a mixture of biological nutrients and zero-valent iron) to accelerate the breakdown of VOCs to nontoxic compounds
- Install a below-ground barrier in the northwest portion of IR-02 to control discharge of contaminated groundwater (containing primarily metals and PCBs) into San Francisco Bay (below-ground barrier would work, in combination with protective liner installed under the soil cover in this area, to limit contaminant migration)
- Monitor groundwater concentrations and plumes to support the selected remedies, including documenting the beneficial impact to groundwater quality following implementation of the selected remedies (e.g., the ongoing degradation of VOC contamination by natural processes)

NAPL at IR-03

- Remove or treat contaminated materials at the Former Oily Waste Ponds (primarily NAPL, but also including associated soil and groundwater contamination)
- Install below-ground barrier to control discharge of NAPL and contaminated groundwater into San Francisco Bay (below-ground barrier would work, in combination with protective liner installed under the soil cover in this area, to limit contaminant migration)
- Treat VOC and TPH contamination in groundwater using injected biological nutrients to accelerate the breakdown of chemicals to nontoxic compounds

Radionuclides (also referred to as radiologically impacted media)

- Perform surveys in areas with potential radiological contamination (including structures, former building sites, and buried storm drain and sewer lines), and separate and dispose of materials and soil with radiological contamination found during the surveys (the final radiological cleanup has been initiated under a time-critical removal action in all of Parcel E areas, except IR-02 and IR-03, and is scheduled to be completed in 2015)
- Perform the following activities throughout IR-02 and IR-03: (1) scan the entire area for radioactivity to a depth of at least 1 foot; (2) separate and dispose of materials and soil with radiological contamination found during the surveys; (3) construct, inspect, and maintain a 2-foot-thick soil cover (as provided by the selected remedy for soil) to prevent exposure to remaining contaminants (the soil cover at IR-02 and IR-03 would also include a demarcation layer to mark the boundary between the existing surface and the soil cover); (4) use ICs (specific to radionuclides) to restrict specific land uses and activities (e.g., to ensure the integrity of the soil cover and demarcation layer); and (5) monitor groundwater to demonstrate, consistent with the findings of previous radiological investigations, that radionuclides are not present in groundwater at activity levels that are both statistically significant and pose an unacceptable risk to human health and the environment

1.2. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state statutes and regulations that are applicable or relevant and appropriate to the remedy, and is cost-effective. The selected remedy uses permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. It provides the best balance of tradeoffs relative to the five balancing criteria and properly considers the two modifying criteria[6]. The selected remedy satisfies the statutory preference for treatment[7] as a principal element through the treatment of VOC contamination in portions of Parcel E and the treatment of the NAPL source at the Former Oily Waste Ponds. Statutory five-year reviews pursuant to CERCLA § 121 and the NCP will be conducted because the remedy will leave contamination in place at Parcel E above concentrations that allow for unlimited use and unrestricted exposure.

[6] As defined in the NCP (Title 40 Code of Federal Regulations § 300.430[f][1][i]), the five primary balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. State and community acceptance are modifying criteria that shall be considered in remedy selection.

[7] As defined in the NCP (Title 40 Code of Federal Regulations § 300.5), "treatment technology" means any unit operation or series of unit operations that alters the composition of a hazardous substance or pollutant or contaminant through chemical, biological, or physical means so as to reduce toxicity, mobility, or volume of the contaminated materials being treated. Treatment technologies are an alternative to land disposal of hazardous wastes without treatment.

1.3. DATA CERTIFICATION CHECKLIST

The following information is included in Section 2 of this ROD. Additional information can be found in the Administrative Record file for this site:

- Chemicals of concern (COCs) and chemicals of ecological concern (COECs) and their concentrations (Sections 2.3 and 2.5).
- Baseline risk represented by COCs and COECs (Section 2.5).
- Remediation goals established for COCs and COECs and the basis for these goals (Sections 2.5 and 2.7).
- Principal threat wastes (Section 2.6).
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater (Section 2.4).
- Potential land and groundwater use that will be available at Parcel E as a result of the selected remedy (Section 2.9.3).
- Estimated capital costs, annual operation and maintenance, and total present-worth costs; discount rate; and the number of years over which the remedy cost estimate is projected (Section 2.8).
- Key factors that led to selecting the remedy (e.g., a description of how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision; Section 2.9.1).

1.4. AUTHORIZING SIGNATURES

This signature sheet documents the Navy's and EPA's co-selection of the remedy in this ROD. This signature sheet also documents the State of California's (DTSC and Water Board) concurrence with this ROD.

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12/12/2013
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Date

Section 2. Decision Summary

2.1. SITE DESCRIPTION AND HISTORY

HPNS is located in southeastern San Francisco on a peninsula that extends east into San Francisco Bay (see Figure 1). HPNS consists of 866 acres: 420 acres on land and 446 acres under water in the San Francisco Bay. In 1940, the Navy obtained ownership of HPNS for shipbuilding, repair, and maintenance activities. After World War II, activities at HPNS shifted to submarine maintenance and repair. HPNS was also the site of the Naval Radiological Defense Laboratory (NRDL).

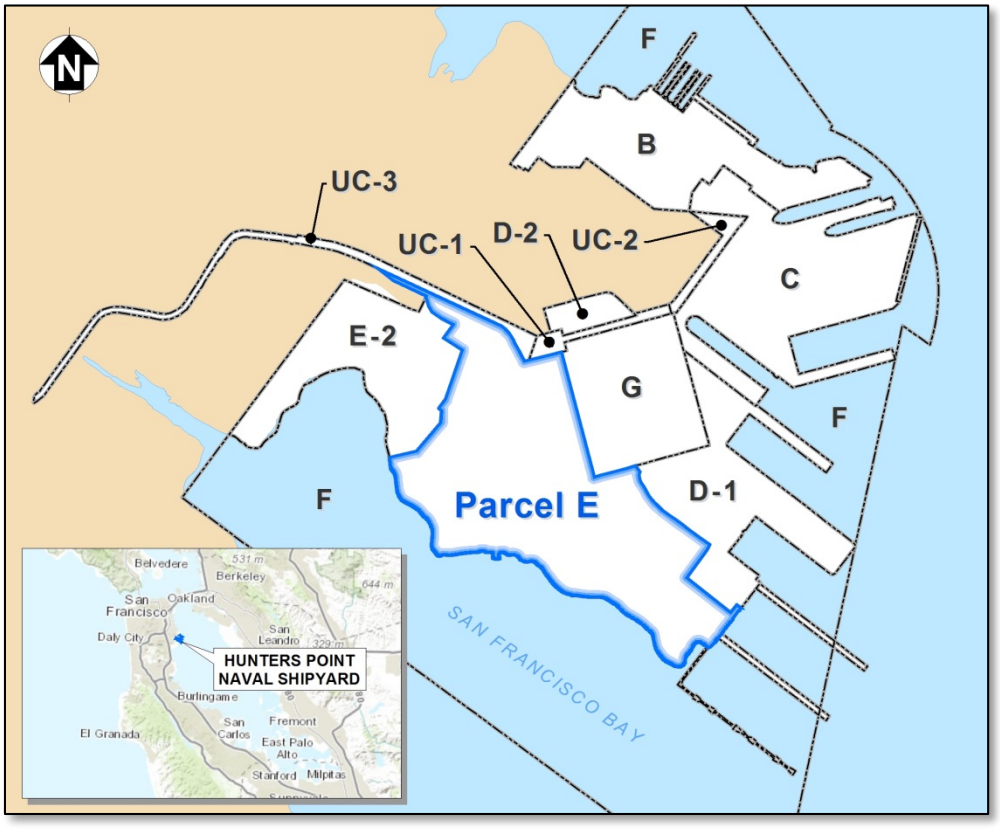

Figure 1. Facility and Parcel E Location Map

HPNS was deactivated in 1974 and remained relatively unused until 1976. Between 1976 and 1986, the Navy leased most of HPNS to Triple A Machine Shop, Inc. (Triple A), a private ship repair company. In 1987, the Navy resumed occupancy of HPNS. Because past shipyard operations left hazardous substances on site, HPNS property was placed on the NPL in 1989 pursuant to CERCLA, as amended by SARA. In 1991, HPNS was designated for closure pursuant to the Defense Base Closure and Realignment Act of

1990. Closure activities at HPNS involve conducting environmental remediation and making the property available for nondefense use.

Parcel E(1), which includes about 128 acres of shoreline and lowland coast along the southwestern portion of HPNS (see Figure 1), contains 17 existing buildings, 25 former buildings, and 1 ship berth. Historically, most of Parcel E was used as an industrial support area, including a warehouse (Building 406) where chlorinated solvents were spilled and Former Oily Waste Ponds (referred to as IR-03) where waste oil was stored from 1944 to 1974. Shoreline areas at Parcel E (referred to as IR-02) were used to store construction and industrial materials, as well as to dispose of industrial waste and construction debris. The NRDL used several Parcel E buildings during the 1950s and 1960s. During its occupancy of HPNS, Triple A allegedly disposed of hazardous wastes at various locations at HPNS, including possibly discharging waste oil within Parcel E using below-ground fuel and steam lines. Areas with historical activities that may have resulted in contamination were identified by reviewing historical records and categorized as **IR sites**(2). The potential contamination at the IR sites was evaluated through a series of investigations, which are described in Section 2.3. Figure 2 identifies the IR sites within Parcel E, and Figure 3 identifies the Parcel E areas with historical shipyard operations, including NRDL buildings and Triple A sites.

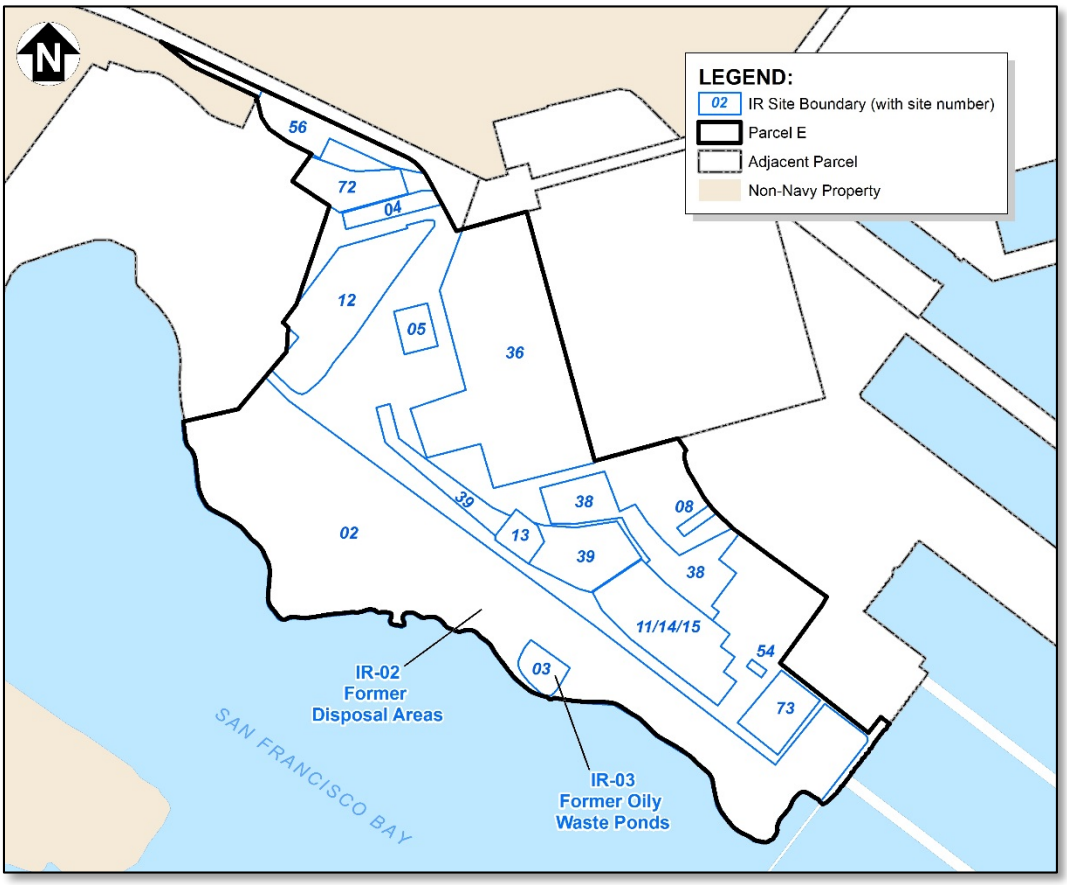

Figure 2. IR Sites at Parcel E

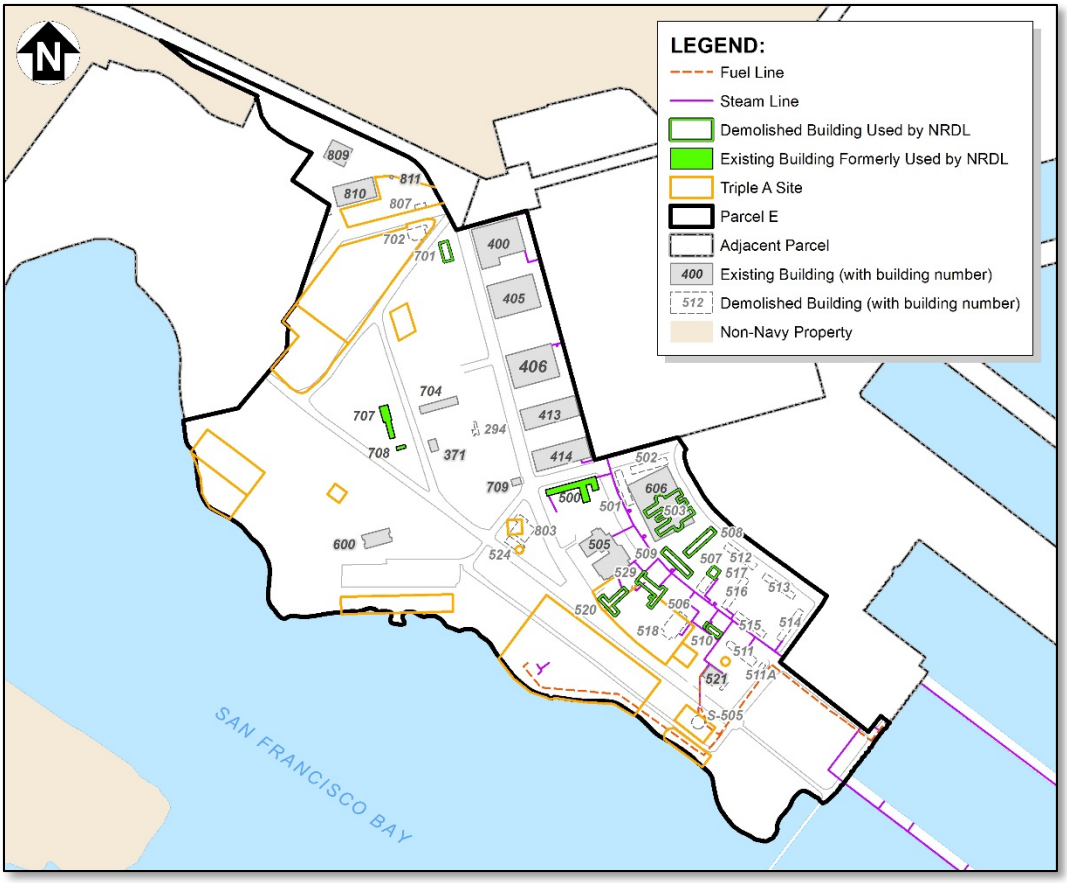

Figure 3. Areas with Historical Shipyard Operations at Parcel E

A history of radiological operations by the Navy at HPNS is presented in Volume II of the Historical Radiological Assessment (HRA). The review of previous radiological activities, cleanup actions, and release surveys identified no imminent threat or substantial risk to tenants or the environment of HPNS or the local community. The HRA identified **radiologically impacted areas**(3) at Parcel E (see Figure 4), which have the potential for radioactive contamination based on historical information or are known to contain or have contained radioactive materials.

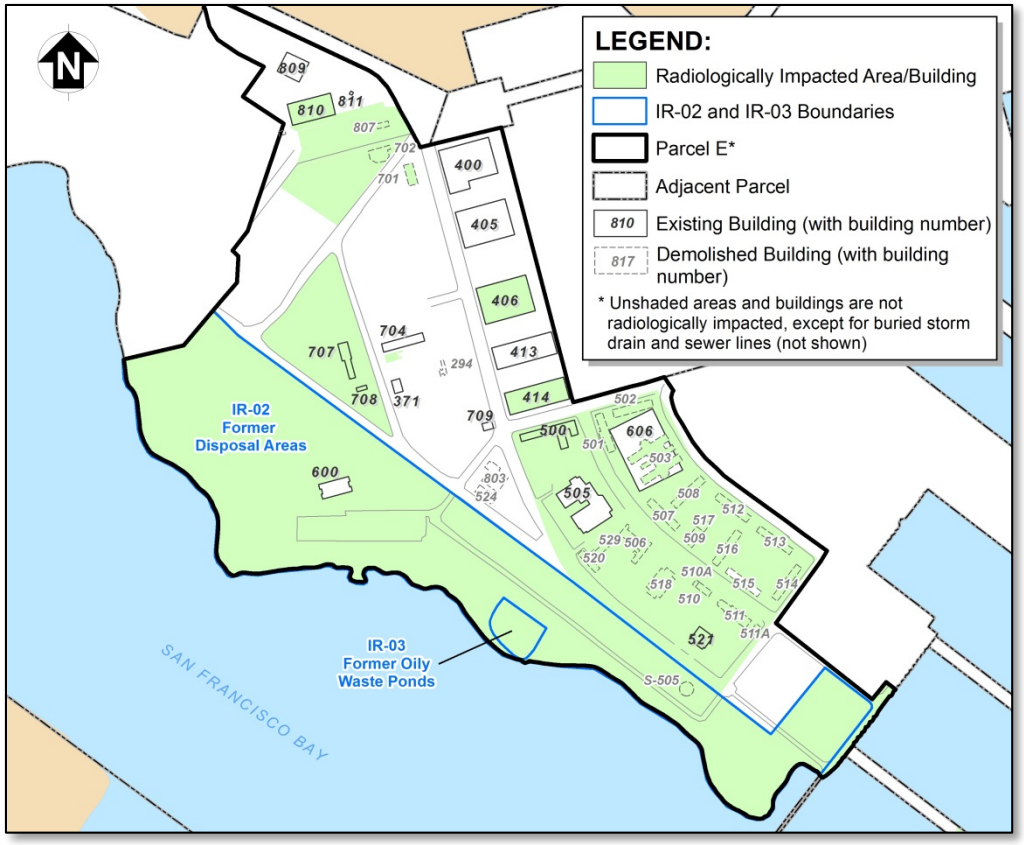

Figure 4. Radiologically Impacted Areas

Two general sources of potential radioactive contamination exist at Parcel E: research activities at various buildings formerly occupied by NRDL and historical waste disposal activities that occurred along the shoreline (IR-02 and IR-03). The NRDL performed practical and applied research on radiation decontamination methods and on the effects of radiation on living organisms and natural and synthetic materials. NRDL primarily conducted research activities within the former 500 series buildings and within the Building 707 Triangle Area. NRDL activities at these buildings may have discharged small amounts of low-level radioactive liquids into sanitary sewer, storm drain, and septic sewer lines; as a result, sanitary sewer, storm drain, and septic sewer lines throughout Parcel E are radiologically impacted. Historical activities in IR-02 and IR-03 included the disposal of radioluminescent commodity items (such as dials, gauges, and deck markers) in conjunction with the disposal of other construction debris and industrial wastes.

The **2010 redevelopment plan for HPNS**(4) identifies two future land use districts located partially in Parcel E: the Shipyard South Multi-Use District and the Shipyard Shoreline Open Space District. For evaluation purposes in the FS Report, the portions of these two land use districts within Parcel E were subdivided into eight reuse areas (see Figure 5). The Shipyard South Multi-Use District encompasses the central and northern portion of Parcel E, and was divided into reuse areas MU-1, MU-2, and MU-3. The Shipyard Shoreline Open Space District encompasses the shoreline area and the southern portion of Parcel E

and was divided into reuse areas EOS-1 through EOS-5. EOS-5, which is contiguous with future open space areas within adjoining Parcel E-2, is shown on Figure 5 as EOS-5A, EOS-5B, and EOS-5C). Section 2.4 further describes the current and future land use of Parcel E.

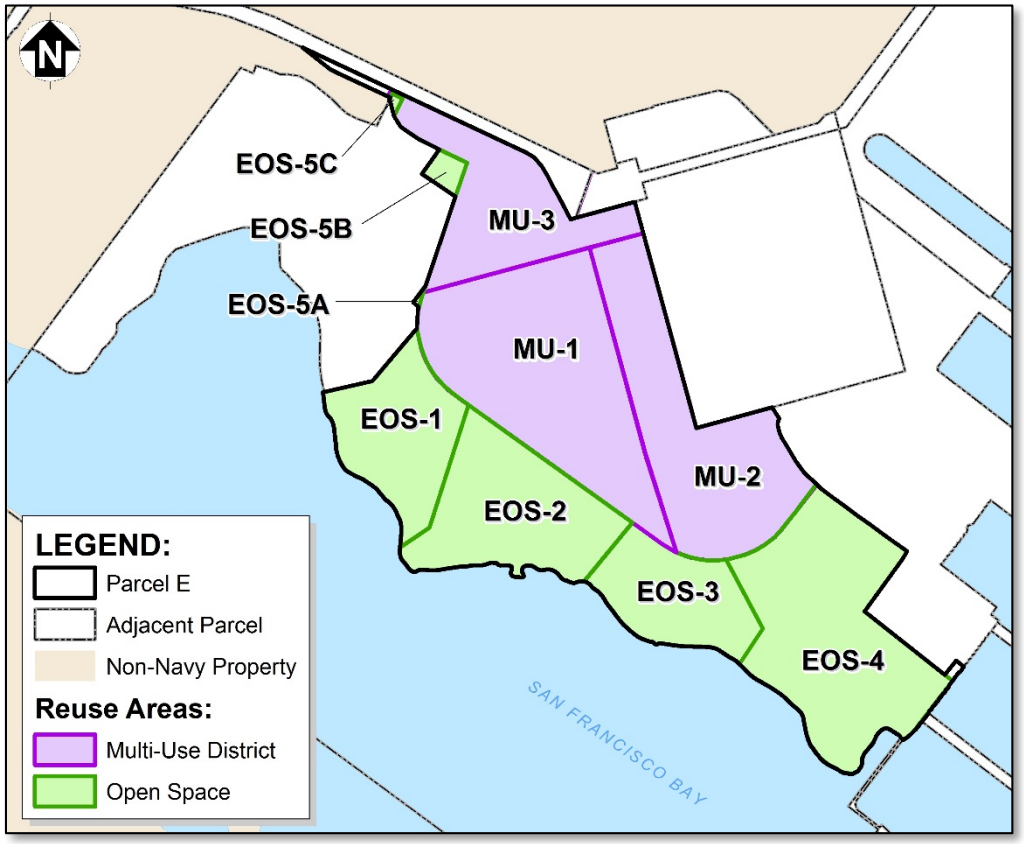

Figure 5. Reuse Areas

2.2. SITE CHARACTERISTICS

Land at HPNS consists of relatively level lowlands constructed by excavating portions of surrounding hills and placing nonengineered fill materials[8] along the margin of San Francisco Bay. The remaining land is a moderate to steep sloping, northwest-trending ridge. Parcel E is located in the lowlands with surface elevations ranging from 0 to 12 feet above mean sea level (msl). Ground surface elevations across most of Parcel E range from 7 to 10 feet above msl; elevations within the narrow intertidal shoreline zone range from about 0 to 4 feet above msl.

The **hydrostratigraphy**(5) of Parcel E consists of four distinct units: the shallow A-aquifer, several aquitard zones, the deeper B-aquifer, and underlying bedrock water-bearing zone. An aquitard zone separates the A- and B-aquifer across most of Parcel E, except for a small area along the northern border of Parcel E

[8] The nonengineered fill materials that were derived from serpentinite bedrock contain minerals with relatively high concentrations of certain metals, including arsenic, iron, manganese, mercury, nickel, and vanadium.

(adjacent to Crisp Road within Parcel UC-3). The presence of additional aquitard zones within B-aquifer sediments isolates the uppermost portions of the B-aquifer from the lower portions of the B-aquifer. Groundwater is not currently used for any purpose at Parcel E. Groundwater in the A-aquifer is not suitable as a potential source of **drinking water**(6). Based on an evaluation of site-specific conditions relative to pertinent regulatory criteria, groundwater in the B-aquifer has a moderate potential to be used as a future source of drinking water; however, the potential use of B-aquifer groundwater is subject to local regulatory controls.

The City and County of San Francisco (CCSF) regulates the installation and use of water wells within city boundaries under Article 12B of the CCSF Health Code. Under the Health Code, San Francisco Public Utilities Commission (SFPUC) administers the withdrawal and use of groundwater within the CCSF, including the South San Francisco Groundwater Basin in which Parcel E is located. The South San Francisco Basin is generally inadequate to supply a significant amount of groundwater for municipal supply (primarily due to low yield). As such, the SFPUC does not provide for the use of groundwater from the South San Francisco Basin. CCSF currently obtains its municipal water supply from the Hetch Hetchy watershed in the Sierra Nevada and plans to continue using the Hetch Hetchy watershed as a drinking water source in the future.

Groundwater flow patterns(7) within the A-aquifer (see Figure 6) at Parcel E are complex because they are potentially affected by a groundwater divide in the northwest portion of IR-02 and submerged utility lines throughout Parcel E (which, if leaking, may allow groundwater to infiltrate into them). The natural flow of groundwater toward San Francisco Bay from the topographically high area of the former Parcel A is disrupted by the groundwater divide along the northwest portion of IR-02. The effect of the submerged utility lines on A-aquifer groundwater flow patterns has been reduced because these lines are inactive and are in the process of being removed (to address potential radiological contamination).

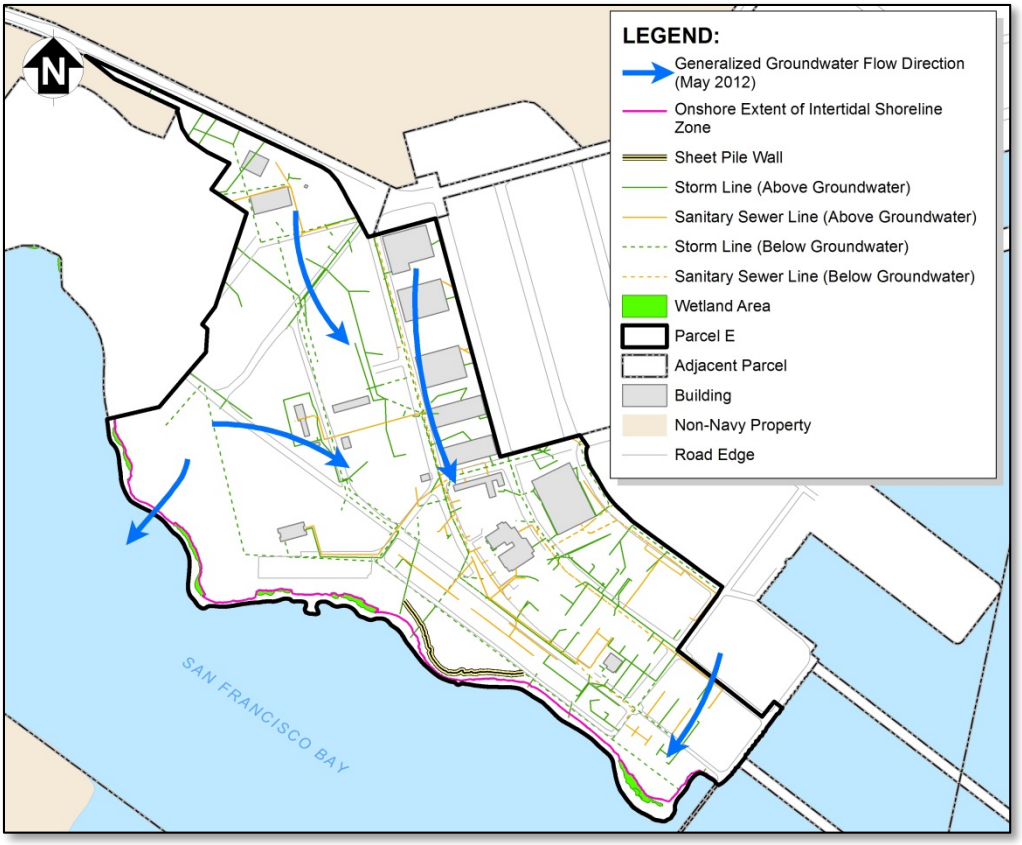

Figure 6. Parcel E Site Features

Parcel E ecology(8) includes terrestrial habitat, aquatic environments, and transitional wetlands. All of these ecological areas have been disturbed by human activities such as excavation, filling, and development, and support relatively few plant species. Birds, mammals, and reptiles have been observed in this parcel. No threatened or endangered species are known to inhabit Parcel E or its immediate vicinity. The existing wetlands within the intertidal shoreline zone (see Figure 6) provide habitat for wintering and migrating wildlife; however, their value in terms of social significance, effectiveness, and opportunity is low because the wetlands are located on manmade land that has been disturbed by human activities and contains chemical contamination.

2.3. PREVIOUS INVESTIGATIONS AND REMOVAL ACTIONS

Parcel E contains several environmental investigation sites identified at HPNS during the Initial Assessment Study conducted by the Navy in 1984. Since that time, the Navy has performed multiple environmental investigations at Parcel E to further evaluate 21 IR sites associated with former shipyard operations. The Navy has also performed several treatability studies that involved testing of technologies to reduce VOCs in groundwater and soil. The Navy has collected extensive information during these investigations and studies, as well as during ongoing environmental monitoring programs for groundwater.

The Revised RI Report (May 2, 2008), FS Report (August 31, 2012), and radiological addendum to the FS Report (August 31, 2012) summarize the results of the environmental investigations at Parcel E and document the site conditions. The previous investigations provide sufficient information to evaluate site risks, develop remedial alternatives, and support the remedy decision made in this ROD.

The Navy has also performed several removal actions at Parcel E to minimize potential exposure to hazardous chemicals. The previous excavations successfully removed significant amounts of contamination from Parcel E but some contamination remains. Table 1 summarizes the investigations, treatability studies, and removal actions performed at Parcel E.

Table 1. Previous Investigations, Treatability Studies, and Removal Actions

Date(s)	Investigation/Study/ Removal Action[a]	Investigation/Treatability Study/Removal Action Activities
1984	Initial Assessment Survey	The Initial Assessment Study was based on reviews of records and interviews of previous workers at the site. Based on the findings of the study, five of the eight sites (IR-02, IR-03, IR-04, and IR-05) were recommended for further evaluation.
1987	Confirmation Study and Verification Step	Activities included a geophysical survey; subsurface exploration using exploratory borings; and soil, groundwater, and air sampling. The study verified the presence of hazardous waste contamination at IR-02, IR-03, IR-04, IR-05, and IR-11.
1987	Area Study	The study consisted of soil sampling to evaluate the potential presence of ACM. ACM was detected in subsurface soil at IR-11/14/15, IR-12, and IR-36 that was attributed to naturally occurring asbestos derived from the serpentinite bedrock.
1988	Fence-to-Fence Survey	Conducted to inventory suspected and known hazardous wastes and materials. The survey report concluded tenants generally managed hazardous wastes and materials in ways that did not pose an immediate environmental threat to HPNS.
1988 to 1989	Solid Waste Air Quality Assessment Test	Focused evaluation of meteorological conditions, ambient air quality, surface gas emissions, and subsurface gas migration at the Parcel E-2 Landfill, but also included limited investigation at Parcel E sites IR-02, IR-03, IR-12, and IR-14. Subsurface methane gas was detected in isolated pockets at IR-03 and in the southern portion of IR-12; however, no available information suggested that subsurface methane was migrating from these locations.
1988	RI Phase 1 Reconnaissance	Evaluated hydrogeologic conditions and identified waste boundaries using GPR, electromagnetic survey, and test pits to delineate the extent of waste depositions in fill material. Results were used to identify data needs for subsequent RI activities.
1988	Basewide Removal of PCB-Containing Electrical Transformers	Forty-eight transformers were removed from Parcel E and disposed of off site.
1988	Removal of Soil at IR-08 PCB Spill Area	About 1,255 cubic yards of soil with PCBs was excavated from a PCB spill area, which underlies the southeast portion of Building 606.

Table 1. Previous Investigations, Treatability Studies, and Removal Actions *(continued)*

Date(s)	Investigation/Study/ Removal Action[a]	Investigation/Treatability Study/Removal Action Activities
1989 to 1990	Preliminary Assessment	Additional areas where leaks or spills of chemicals were suspected or identified were evaluated and recommended for further action during the site inspection. The following Parcel E sites were evaluated as part of this assessment and recommended for further action: IR-12 through IR-15, IR-36 North, IR-36 South, IR-36 West, IR-38, IR-39, IR-40, IR-52, IR-54, IR-56, and portions of facilitywide utility systems. IR-12 and IR-15 were carried forward directly to the RI phase (IR-14/IR-15 were combined with IR-11), and the remaining sites were carried forward to the site inspection phase.
1991	Removal of Floating Product at IR-03	About 25 gallons of floating petroleum product on the water table and 70 gallons of subsurface waste oil were recovered by pumping and disposed of off site.
1991 to 1992	Intertidal Sediment Study	Sediment samples were collected in the intertidal zone, and the resulting data were used to identify COPECs in the Phase 1A ERA.
1991 to 1992	Phase I Radiological Investigation	The surface confirmation radiation survey detected elevated gamma activity in a centralized area of IR-02 Northwest that extended across the IR-02 Central boundary; these results indicated the presence of radium-containing devices.
1991 to 1994	Removal and Closure of ASTs and USTs	Ten USTs were located in Parcel E: 2 were closed in place and 8 were removed. Parcel E also contained 32 ASTs, including Tank S-505, a 630,000-gallon tank at IR-02 Southeast. In total, 12 of 32 ASTs (including Tank S-505) were removed.
1991 to 1995	Sandblast Waste Fixation	More than 4,900 tons of sandblast waste was collected from locations around HPNS, temporarily stockpiled at Parcel E, and sent to an asphalt plant for recycling.
1992 to 1996	RI Report	Based on the results from more than 4,700 soil and 1,200 groundwater samples, the RI Report recommended that all Parcel E sites be carried forward to an FS. Additionally, the report noted that additional soil and groundwater samples should be collected to better define the nature and extent of contamination at the parcel. The Parcel E RI also included a baseline ERA and HHRA.
1992, 1994, and 1996	Facilitywide Ambient Air Monitoring	Results indicated that concentrations of asbestos, metals, and VOCs were not present or present at very low concentrations that were similar to regional background concentrations. As a result, no further actions or studies for ambient air at HPNS were recommended.
1993	Phase II Radiological Investigation	Investigation delineated the subsurface distribution of radium-containing devices in the disposal area at IR-02 Northwest and IR-02 Central. A removal action was recommended to address radiological contamination in this area. The removal action at IR-02 Northwest and IR-02 Central was performed from 2005 to 2007.
1993 to 1994	Site Inspection	Based on soil and groundwater sample results, the Site Inspection Report recommended further evaluation of IR-36, IR-38, IR-39, IR-40, IR-52, IR-54, and IR-56 as part of the RI phase. The report also recommended that the utility sites (IR-45, IR-47, and IR-50) be investigated further in the RI phase.

Table 1. Previous Investigations, Treatability Studies, and Removal Actions *(continued)*

Date(s)	Investigation/Study/ Removal Action[a]	Investigation/Treatability Study/Removal Action Activities
1993 to 1994	Site Assessment	Evaluated areas that had not been previously investigated under the IR Program because of lack of access or documentation. The assessment recommended further investigation at three areas in Parcel E (subsequently identified as IR-11, IR-72, and IR-73).
1996	Removal of Soil from IR-11/14/15	About 36 cubic yards of arsenic- and mercury-contaminated soil was excavated from an area east of Building 521 at IR-11/14/15.
1996 to 1997	Phase III Radiological Investigation	The investigation included surveys and swipe sampling at former NRDL buildings at Parcel E. Based on the investigation results, the report recommended (1) further investigation and potential excavation at former Buildings 509 and 517, where anomalous gamma activity was measured; (2) excavation of a potential buried point source behind Building 529; and (3) further investigation of Building 707 and its concrete pad.
1996 to 1997	Removal of Sediment from the Storm Drain System	More than 1,200 tons of sediment and debris was removed from storm drain lines across HPNS, including from storm drain lines in Parcel E, to reduce the potential for chemicals to be transported to San Francisco Bay.
1996 to 1998	Installation of Sheet Pile Wall and Low-Permeability Cap at the Former Oily Waste Ponds in IR-03	A 900-foot-long sheet pile wall was installed to a maximum depth of 27 feet below ground surface to reduce the potential for oil to migrate from IR-03 to San Francisco Bay. A geosynthetic clay liner with a 1-foot topsoil layer was placed over the area to minimize rainfall infiltration.
1997 to 1998	Parcel E FS Report	Based on the data presented in the RI Report, the FS Report identified and evaluated remedial alternatives for Parcel E. However, the FS Report was not finalized because the Department of the Navy and regulatory agencies identified additional tasks to better characterize the nature and extent of contamination at Parcel E. These tasks were performed as part of data gaps investigations from 2000 through 2003, and results of these investigations were used in Revised RI and FS Reports for Parcel E.
1998 to 1999	Phase IV Radiological Investigation	Investigation involved collecting and analyzing 38 concrete and 38 soil samples from the Building 707 concrete pad area. Based on results from the investigation, a removal action was recommended to address elevated radioactivity at the concrete pad. The removal action at Building 707 was performed as part of the basewide radiological removal action that was initiated in 2009.
1999 to 2000	Parcel E Validation Study and Protective Soil Concentrations Technical Memorandum	Results of the study concluded cadmium, copper, lead, nickel, selenium, and zinc posed a potential unacceptable risk to wildlife at Parcel E. Protective soil concentrations were subsequently derived for these chemicals and used to evaluate risk to wildlife in the Revised Parcel E RI Report.
2000 to 2002	Groundwater Data Gaps Investigation	Water level measurements and results of a tidal study were used to refine the Parcel E hydrogeological conceptual model, and three rounds of groundwater monitoring data were used to develop a basewide groundwater monitoring program and to refine the nature and extent evaluation presented in the Revised RI Report.

Table 1. Previous Investigations, Treatability Studies, and Removal Actions *(continued)*

Date(s)	Investigation/Study/ Removal Action[a]	Investigation/Treatability Study/Removal Action Activities
2000 to 2002	SVE Treatability Study	A SVE treatability study was performed inside and immediately northwest of Building 406. The SVE system, which consisted of 3 SVE wells and 15 vapor monitoring wells, removed about 7 pounds of VOCs, with over 90 percent of the VOC mass attributed to TCE.
2001	Removal of Soil with Non-VOCs at IR-08	About 1,550 cubic yards of PCB- and PAH-contaminated soil was excavated from four remediation areas at IR-08.
2001	Radiological Investigation of Parcel E Shoreline	Several areas contained gamma activity at levels exceeding background, most notably in the Metal Reef Area in IR-02 Southeast. A removal action was recommended to address radioactive materials in this area. The removal action at the Metal Reef Area was performed from 2005 to 2007.
2001 to 2002	Wetland Delineation and Wetland Functions Assessment	About 0.73 acres of tidal wetland areas were identified along the Parcel E shoreline. The functions and values assessment found that the value of these wetlands is low, and the most significant function of these wetlands to be seasonal wildlife use for wintering and migrating birds.
2002	Standard Data Gaps Investigation	Data from this investigation were used in the Revised Parcel E RI Report to identify potential source areas of contamination, evaluate the nature and extent of soil contamination in each reuse area, and evaluate risk to human health and the environment.
2002 to 2004	Waste Consolidation and Removal	Industrial process equipment was decontaminated and waste was consolidated throughout Parcel E, including removal of waste material stored in or near buildings and removal or encapsulation of ACM. Eight ASTs located at Building 521 were also removed.
2002 to 2005	Parcels E and E-2 Shoreline Investigation and Risk Assessment	Shoreline investigation and associated ERA identified a potential risk to benthic invertebrates, birds, and mammals from exposure to metals and total PCBs in surface and subsurface sediments along the shoreline. Based on these results, source control measures were recommended for the Parcel E shoreline, particularly in IR-02 Northwest.
2002 to 2003	Phase V Radiological Investigation	At Parcel E, 21 buildings or former building locations were evaluated as part of Phase V. Investigation activities consisted of conducting surveys, collecting samples, and performing remedial activities. Several areas with elevated levels of radioactivity were reported. Future investigation and cleanup were recommended for several sites, including Building 406; the area around former Buildings 506, 520, and 529; the Building 707 concrete pad and drains; the Shack 80 site; and IR-04.
2003 to 2004	HRA	The HRA identified 33 areas in Parcel E as radiologically impacted. These sites included small areas such as former building foundation footprints and fill areas that may contain dials, gauges, deck markers, or sandblast waste. The HRA also identified basewide utility systems as impacted sites, including the underground storm drain and sanitary sewer lines. The HRA reported that no radiological contamination was suspected in groundwater at Parcel E, except at IR-02 and areas where storm drains are present; these areas have a low potential for groundwater contamination. The HRA concluded that further evaluation of the impacted sites was required.

Table 1. Previous Investigations, Treatability Studies, and Removal Actions *(continued)*

Date(s)	Investigation/Study/ Removal Action[a]	Investigation/Treatability Study/Removal Action Activities
2003 to 2004	Parcel E Shoreline Debris Removal	Bricks and other industrial debris along the Parcel E shoreline were collected for disposal. About 468 cubic yards of non-RCRA hazardous waste debris (poles with creosote), about 400 cubic yards of nonregulated nonhazardous debris, and about 81 tons of recyclable metals were removed.
2003 to 2004	Removal of Soil Stockpiles	A field inventory of soil stockpiles at HPNS identified multiple stockpiles at IR-02 Southeast and IR-73. In total, about 3,000 cubic yards of soil, 150 cubic yards of gravel, and 22 cubic yards of other material were removed and disposed of off site.
2004	Removal of TPH-Contaminated Soil from Various Locations	Six areas at IR-05, IR-36 West, IR-39, and IR-73 were excavated to remove soil containing TPH at concentrations exceeding the screening criterion of 3,500 mg/kg. More than 13,000 cubic yards of soil was removed from these areas and disposed of off site.
2004 to Present	Basewide Groundwater Monitoring Program	Monitors groundwater on a quarterly basis at HPNS. Most locations included in the program exhibited chemical concentrations that pose potential risk to humans and wildlife.
2005 to 2007	Metal Debris Reef Removal Action	Approximately 11,200 cubic yards of soil, metal slag, and debris was removed from the Metal Debris Reef (in IR-02 Southeast). Low-level radioactive waste removed from the site included 131 devices and button sources and 31 cubic yards of metal debris.
2005 to 2007	Removal of Soil at IR-02 Northwest and IR-02 Central Area	Approximately 49,500 cubic yards of soil was excavated and tested for radioactive substances. Low-level radioactive waste removed from the site included 11,840 tons of soil, 2,342 devices and button sources, 420 tons of firebrick, 1,940 tons of metal debris, and 58 tons of miscellaneous debris (concrete, plastic, hoses, and rocks). After removing the radioactive waste, the soil was used to backfill the excavation.
2009 to 2012	Groundwater Characterization and ZVI Treatability Study at Various VOC Groundwater Plumes	The study further characterized VOC groundwater plumes in Parcel E and evaluated the effectiveness of ZVI injection in reducing VOC concentrations at two plumes (IR-12 PCE plume and Building 406 TCE plume). The characterization refined the extent of the VOC groundwater plumes and identified elevated VOCs in soil gas at IR-04 and IR-36 (Building 406). The study determined that ZVI could effectively treat the VOC plumes but recommended additional monitoring to better assess post-injection groundwater conditions.
2009 to Present	Basewide Radiological Removal Action	Activities in Parcel E are designed to identify and remove low-level radiological material with radioactivity levels exceeding the remediation goals at all radiologically impacted sites outside of IR-02 and IR-03, which includes the 500 series buildings, Building 707 triangle area, and storm drain and sewer lines. The fieldwork is scheduled for completion in 2015.
2011 to Present	Characterization and Treatability Study at IR-03	An initial study (from 2011 to 2012) further characterized the extent of NAPL at IR-03, and tested heating technologies (to enhance NAPL removal) on a bench-scale. A follow-on study was initiated in 2013 and further characterized the NAPL; a second phase of the study will be implemented in 2014 to test two technologies (in-situ stabilization/solidification and thermally enhanced NAPL extraction) in the field.

Table 1. Previous Investigations, Treatability Studies, and Removal Actions *(continued)*

Date(s)	Investigation/Study/ Removal Action[a]	Investigation/Treatability Study/Removal Action Activities
2012 to 2013	Soil Characterization at Various Locations	The study further characterized areas with soil contamination that significantly exceeded screening criteria (by at least five times). The characterization helped to delineate areas that may require excavation and offsite disposal in the future.

Notes:

a = The documents listed are available in the Administrative Record and provide detailed information used to support remedy selection at Parcel E.

ACM = asbestos-containing material
ASTs = aboveground storage tanks
COPECs = chemicals of potential ecological concern
ERA = ecological risk assessment
FS = Feasibility Study
GPR = ground-penetrating radar
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard
HRA = Historical Radiological Assessment
IR = Installation Restoration
mg/kg = milligrams per kilogram
NAPL = nonaqueous-phase liquid
NRDL = Naval Radiological Defense Laboratory
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PCE = tetrachloroethene
RCRA = Resource Conservation and Recovery Act
RI = Remedial Investigation
SVE = soil vapor extraction
TCE = trichloroethene
TPH = total petroleum hydrocarbons
USTs = underground storage tanks
VOCs = volatile organic compounds
ZVI = zero-valent iron

Figure 7 identifies the locations of several removal actions conducted at Parcel E, which have addressed radiological contamination in numerous areas pursuant to a **Basewide Time-Critical Removal Action Memorandum**(9). The removal action to address the radiologically impacted sites in Parcel E (outside of IR-02 and IR-03) began in 2009 and is scheduled for completion in 2015. All interim reports will be summarized in a final removal action completion report (RACR), which will be reviewed and approved by the FFA signatories and the California Department of Public Health (CDPH). Although the removal action will not be completed by the time this ROD is signed, the removal action is intended to achieve cleanup goals identical to the remedial action objectives (RAOs) specified in this ROD. If the removal action does not achieve its cleanup goals, cleanup will continue in accordance with the remedial action selected in this ROD until the RAOs are achieved. The ongoing removal action does not address IR-02 and IR-03 because nonradioactive chemicals in soil and shoreline sediment within these areas require remedial action, which will be performed as part of the selected remedy.

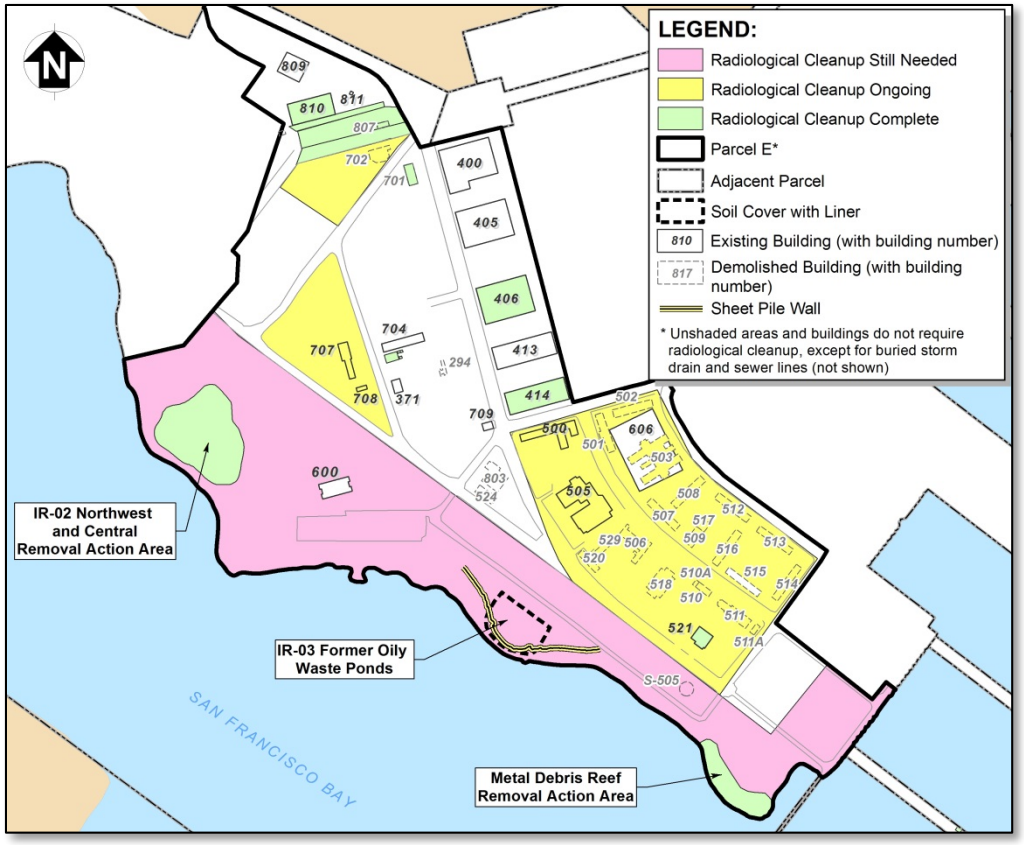

Figure 7. Removal Actions

Based on previous investigations and removal actions, the sources and extent of the remaining contamination in soil, shoreline sediment, and groundwater have been characterized adequately to select an appropriate remedy. Section 2.3.1 summarizes the nature and extent of nonradioactive chemicals in soil and shoreline sediment, and Section 2.3.2 summarizes the nature and extent of nonradioactive chemicals in groundwater. Section 2.3.3 describes the nature and extent of NAPL at IR-03. Section 2.3.4 describes the nature and extent of radionuclides in soil, shoreline sediment, and groundwater at Parcel E.

2.3.1. Nonradioactive Chemicals in Soil and Shoreline Sediment

Soil investigations at Parcel E identified metals, VOCs, SVOCs, PCBs, dioxins and furans, and TPH as the **chemicals in soil that exceeded screening criteria**(10) used in the RI and were present over large portions of Parcel E. The investigations of shoreline sediment indicated that concentrations of copper, lead, mercury, zinc, PCBs, and dichlorodiphenyltrichloroethane (DDT) exceeded screening criteria (used in the RI) in most locations along the Parcel E shoreline and are a **potential source of contamination to Parcel F**(11). Contaminated sediments above msl will be addressed by the selected remedy for Parcel E. Contaminated sediments below msl will be addressed, as necessary, by the selected remedy for Parcel F, the Navy's property offshore of HPNS.

2.3.2. Nonradioactive Chemicals in Groundwater

Groundwater investigations at Parcel E have identified **groundwater plumes**(12) with concentrations of metals, VOCs, PCBs, and TPH that exceeded screening criteria used in the RI. Primary potential migration pathways for contaminated groundwater include migration and discharge of A-aquifer groundwater into San Francisco Bay and volatilization of A-aquifer groundwater (in areas within VOC plumes) into soil gas and then indoor air. The potential risk associated with these migration pathways is described in Section 2.5. Figure 8 shows the groundwater plumes at Parcel E that required further evaluation in the FS Report (as determined by the risk evaluations described further in Section 2.5). An additional groundwater plume, which contained benzene, was identified in IR-39. This plume, however, is attributed to past releases from the underground storage tanks at Building 709 (former Navy exchange gas station), thus it is being addressed under the Navy's TPH corrective action program.

Following identification of the VOC plumes (Figure 8) in the RI, the Navy performed additional studies (from 2009 to 2012) at these areas to better understand the extent of contamination and to evaluate potential cleanup technologies. The additional studies identified **VOCs in soil gas**(13) at concentrations that exceed risk-based screening levels. The VOCs reported in soil gas emanate from either contaminated soil or groundwater in the areas.

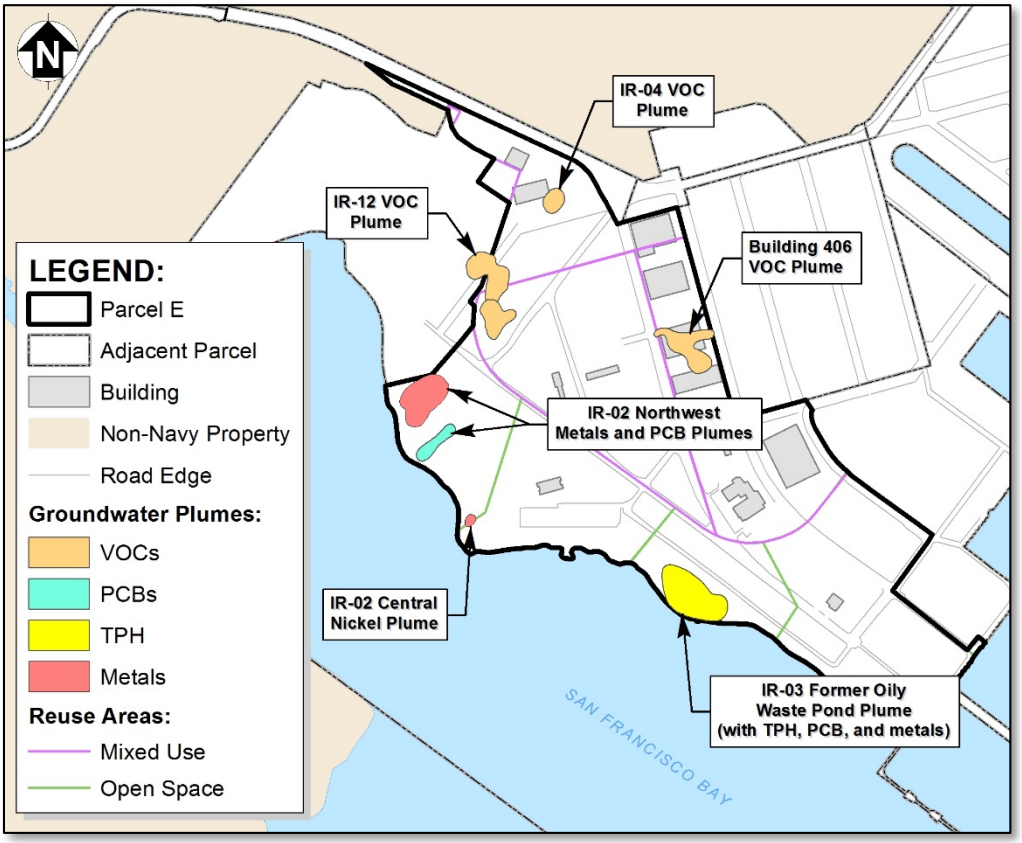

Figure 8. Groundwater Plumes

2.3.3. NAPLs at IR-03

Past investigations have identified **NAPL across large portions of the Former Oily Waste Ponds**(14) (referred to as IR-03) and adjacent portions of IR-02. Most of the NAPL is present at depths ranging from 11 to 18 feet below ground surface (bgs), with isolated locations where NAPL was found as shallow as 8 feet bgs and as deep as 25 feet bgs. The NAPL is highly viscous and contains a mixture of petroleum hydrocarbons and other organic chemicals (including PCBs and aryl phosphates in some locations). The high viscosity of NAPL limits its mobility; however, NAPL appears to be a continuing source to groundwater contamination, as evidenced by elevated chemical concentrations (most notably TPH and PCBs) in groundwater that may pose a risk to aquatic wildlife in the bay (discussed further in Section 2.5). In addition, groundwater monitoring wells located adjacent to the shoreline (bayside of the sheet-pile wall) contain measureable NAPL, indicating that NAPL could discharge to San Francisco Bay. Section 2.8 discusses the remedial alternatives specific to NAPL at IR-03.

As noted in Table 1, the Navy is conducting a study at IR-03, concurrent with this ROD, to further characterize the NAPL and test two technologies (in-situ stabilization/solidification and thermally-enhanced extraction) in the field. The first phase of this study was completed in 2013, and characterized the chemical composition and physical properties of the NAPL. The characterization findings, which identified some additional chemicals (aryl phosphates) that result in a denser NAPL when compared to other oily wastes, were used to develop an **approach for testing thermally-enhanced extraction**(15) in a manner that ensures the protection of human health and the environment. The second phase of the study will be completed in 2014 and will involve field testing of thermally-enhanced extraction and in-situ stabilization/solidification.

2.3.4. Radionuclides in Soil, Shoreline Sediment, and Groundwater

Several radiological investigations(16) have been conducted at radiologically impacted sites at Parcel E, and have included surface scans and collection of soil and groundwater samples for radiological analyses. The most extensive and recent of the radiological investigations, the Phase V investigation, involved the collection of more than 300 soil samples primarily within the location of current and former series 500 buildings and the Building 707 Triangle Area. Soil sample results identified two primary radionuclides of concern (ROCs) at these areas: cesium-137 (^{137}Cs) and radium-226 (^{226}Ra). For evaluation purposes in the radiological addendum to the FS Report, the activity level for each ROC was compared against the corresponding release criterion to provide a general assessment of the distribution of ROCs in surface soil at Parcel E. The assessment results, as identified in the radiological addendum to the FS Report, are as follows:

- The extent of ^{137}Cs in surface soil exceeding the release criterion (0.113 picocurie per gram [pCi/g]) was moderate.
- The extent of ^{226}Ra in surface soil exceeding the release criterion (1.0 pCi/g above the background activity level) was widespread.

As identified in the HRA, shoreline sediment (within the intertidal zone), subsurface soil, and structures at Parcel E are also considered radiologically impacted; however, data are inadequate to support a detailed evaluation of the nature and extent of radionuclides in shoreline sediment, subsurface soil, and structures. In the absence of such data, this ROD assumes that radiologically impacted sediment, subsurface soil, and structures, as identified in the HRA, will require remediation. As described in Section 2.3, the radiologically impacted sites in Parcel E outside of IR-02 and IR-03 are being addressed through an ongoing removal action (initiated in 2009 and scheduled for completion in 2015). Although the radiological removal action will not be completed by the time this ROD is signed, the removal action is intended to achieve cleanup goals identical to the RAOs specified in this ROD. If the removal action does not achieve its cleanup goals, cleanup will continue in accordance with the remedial action selected in this ROD until the RAOs are achieved. The ongoing removal action does not address IR-02 and IR-03 because nonradioactive chemicals in soil and shoreline sediment within these areas will be addressed as part of the selected remedy. Section 2.8 discusses the radiological remedial alternatives for IR-02 and IR-03.

The groundwater data set from previous **radiological groundwater investigations**(17), performed from 2001 to 2002 and 2007 to 2009, consists of 159 samples collected from 37 A-aquifer wells and 4 samples collected from 1 B-aquifer well within Parcel E. The radionuclide groundwater data were evaluated by simple (non-statistical) threshold comparisons to fixed standards (drinking water criteria) and by statistical tests comparing the site data to fixed standards (one-sample statistical tests), if necessary. Through these comparisons, the radiological addendum concluded that groundwater does not appear to have been impacted by radionuclides at activity levels that warrant remedial action. However, nonradioactive chemicals in groundwater within IR-02 and IR-03 require remedial action, including monitoring, ICs, source removal, and containment. Future monitoring will include analysis for radionuclides in groundwater to demonstrate, consistent with the findings of previous radiological investigations, that radionuclides are not present in groundwater at activity levels that are both statistically significant and pose an unacceptable risk to human health and the environment (see Section 2.7 for further information).

2.4. CURRENT AND POTENTIAL FUTURE SITE USES

Parcel E is a former industrial use area with most areas subject to restricted access because of ongoing remediation. Building 606, located in the southeast portion of Parcel E, is the only occupied building at Parcel E; it is currently leased to the San Francisco Police Department. As described in Section 2.1, the future use of Parcel E is described in the CCSF's **2010 redevelopment plan for HPNS**(4), which identifies two future land use districts located partially in Parcel E: the Shipyard South Multi-Use District and the Shipyard Shoreline Open Space District. The Shipyard South Multi-Use District may be used for recreational, industrial, and residential purposes. The Shipyard Shoreline Open Space District may be used for active and passive recreation, plazas and promenades, wetlands restoration, and ancillary commercial use.

As discussed in Section 2.1, the Navy subdivided the two land use districts into smaller reuse areas to facilitate the data presentation in the FS Report. The Navy-defined reuse areas in the portion of the Shipyard South Multi-Use District located in Parcel E are MU-1, MU-2, and MU-3. The Navy-defined reuse areas in the portion of the Shipyard Shoreline Open Space District located in Parcel E are EOS-1 through EOS-4, EOS-5A, EOS-5B, and EOS-5C. Figure 5 presents the planned reuses and reuse areas within Parcel E. It should be noted that the data analysis and risk evaluations presented in the Revised RI Report were based on the 1997 "Hunters Point Shipyard Redevelopment Plan," which included a different combination of future uses in Parcel E (including commercial and industrial uses). However, the Revised RI Report included an evaluation of residential exposures throughout Parcel E, which provides an adequate baseline for the risk evaluations.

Groundwater in the A-aquifer, as discussed in the Revised RI Report, is not suitable for use as **drinking water**(6). Exposures to A-aquifer groundwater were evaluated based on transport of groundwater to San Francisco Bay. Groundwater in the B-aquifer was evaluated as a drinking water source, based on pertinent regulatory criteria, and was determined to have a potential for use as drinking water. However, as described in Section 2.2, CCSF controls the future use of B-aquifer groundwater at HPNS, and the SFPUC does not provide for use of groundwater in this area of the city.

2.5. SUMMARY OF SITE RISKS

Contaminated media at Parcel E consist of soil, soil gas, shoreline sediment, and groundwater. The primary contaminant transport mechanisms are (1) leaching from soil to groundwater by infiltrating precipitation or as a result of fluctuating groundwater levels, (2) discharge from groundwater to surface water through direct discharge or via leaking utility lines, (3) volatilization from soil or groundwater to soil gas and then indoor air, and (4) transport of soil or shoreline sediment to surface water with overland flow of storm water.

Figure 9 provides a general conceptual site model (CSM) for Parcel E. Based on the CSM, Parcel E was evaluated for potential risks to human health and the environment in the Revised RI Report, the FS Report, and the radiological addendum to the FS Report. Section 2.5.1 presents the results of the human health risk assessment (HHRA). Section 2.5.2 presents the results of the ecological risk assessments.

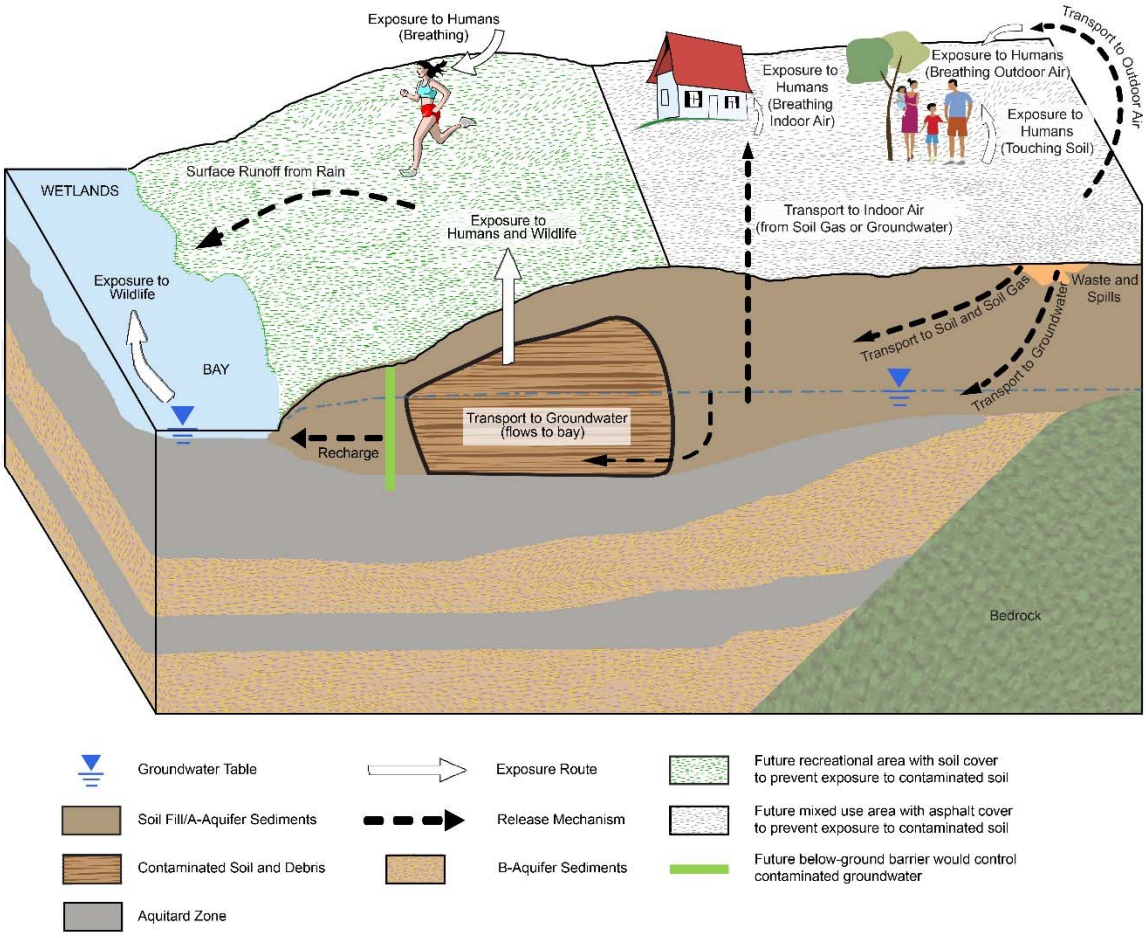

Figure 9. Conceptual Site Model

2.5.1. Human Health Risk Assessment

Based on a **CSM for human health**(18), a **quantitative HHRA**(19) was completed for soil, shoreline sediment, and groundwater at Parcel E. Potential **cancer risks and noncancer hazards**(20) were calculated based on reasonable maximum exposure (RME) assumptions recommended by EPA and DTSC. These assumptions are based on an RME rather than an average or medium range exposure assumption and provide a conservative and protective approach that estimates the highest health risks that are reasonably expected to occur at a site.

Cancer risk is the estimated probability that a person will develop cancer from exposure to site contaminants and is generally expressed as an upper-bound probability. For example, a 1 in 1,000,000 chance is a risk that for every 1,000,000 people, one additional cancer case may occur as a result of exposure to site contaminants. This risk estimate is termed excess cancer risk. The Navy adopted a conservative approach at Parcel E and evaluated action where potential excess cancer risk exceeded 1 in 1,000,000, which meets the most conservative end of the risk management range established by EPA.

Noncancer hazard is the risk of health effects other than cancer, and is expressed as a number called the hazard index (HI). An HI of 1 or less is considered an acceptable exposure level for noncancer health hazards. The Navy evaluated action at Parcel E areas with an HI greater than 1.

The HHRA specifies the **assumptions and uncertainties**(21) inherent in the risk assessment process attributed to a number of factors including the number of samples collected or their location, the literature-based exposure and toxicity values used to calculate risk, and risk characterization across multiple media and exposure pathways. The uncertainties can result in the overestimation or underestimation of the actual cancer risk or HI. In general, the risk assessment process is based on the use of conservative (health protective) assumptions that when combined are intended to overestimate the actual risk.

2.5.1.1. Soil Risk Summary

Both **total excess and incremental excess risks**(22) were evaluated for exposure to soil. For the total risk evaluation, all detected chemicals, except for calcium, magnesium, potassium, and sodium (essential nutrients), were included as chemicals of potential concern (COPCs) regardless of concentration. The total excess risk evaluation provided an estimate of the risks posed by all chemicals at Parcel E, including those present at concentrations at or less than Hunters Point ambient levels (HPALs). The HPALs are an indicator for naturally occurring metals that are part of the soil and rock at the shipyard. For the incremental excess risk evaluation, the essential nutrients and metals with maximum detected concentrations less than HPALs were excluded as COPCs. The incremental excess risk evaluation provided an estimate of risks posed by all chemicals at Parcel E, except those that do not exceed HPALs.

Based on the **HHRA results for nonradioactive chemicals in soil**(23), incremental excess cancer risks exceeded 1 in 1,000,000 and noncancer hazards were greater than 1 (see Table 2). In addition, incremental excess **cancer risks from exposure to radionuclides in soil**(24) exceeded 1 in 1,000,000 (see Table 2).

Table 2. Incremental Excess Cancer Risks and Noncancer Hazards in Soil [a]

Parcel E Reuse Area	Exposure Scenario	Cancer Risk		Noncancer Hazard Index
		Nonradioactive Chemicals	Radionuclides	
EOS-1	Recreational	1 in 10,000	7 in 1,000,000	10
EOS-2	Recreational	9 in 1,000	3 in 10,000	1,700
EOS-3	Recreational	1 in 1,000	2 in 100,000	3.2
EOS-4	Recreational	3 in 10,000	7 in 1,000	9.6
EOS-5A	Recreational	1 in 100,000	--	<1
EOS-5B	Recreational	7 in 100,000	--	<1
EOS-5C	Recreational	--	--	<1
MU-1	Residential	6 in 1,000	7 in 1,000	130
MU-2	Residential	3 in 1,000	9 in 10,000	54

Table 2. Incremental Excess Cancer Risks and Noncancer Hazards in Soil [a] *(continued)*

Parcel E Reuse Area	Exposure Scenario	Cancer Risk		Noncancer Hazard Index
		Nonradioactive Chemicals	Radionuclides	
MU-3	Residential	1 in 1,000	8 in 10,000	65

Notes: Reuse areas are shown on Figure 5 and align with anticipated future use.

a = Listed risk value is maximum incremental risk in each area; risk is based on conditions before cleanup (including prior to interim removal actions, such as those related to radionuclides).

EOS = Parcel E open space (reuse area) MU = multi-use (reuse area) -- = not applicable (i.e., no chemicals of concern in the reuse area)

2.5.1.2. Shoreline Sediment Risk Summary

Total excess risks were evaluated for **direct exposure to shoreline sediment**(25), as well as ingestion of shellfish along the shoreline. For the direct exposure pathway, PCBs were the only chemical with a risk greater than 1 in 1,000,000 (based on RME assumptions). Noncancer hazards for the direct exposure pathway were less than 1. For the shellfish ingestion pathway, the primary risk drivers associated with Parcel E shoreline sediments were arsenic, total PCBs, and dioxins, where cancer risks for these chemicals exceeded 1 in 1,000,000 (based on RME assumptions). Noncancer hazards for the shellfish ingestion pathway were greater than 1, and were attributed to total PCBs.

2.5.1.3. Groundwater Risk Summary

Both total and incremental excess risks were evaluated for exposure to groundwater. Based on the **HHRA results for nonradioactive chemicals in groundwater**(26), incremental excess cancer risks exceeded 1 in 100,000 and noncancer hazards were greater than 1 (see Table 3).

Table 3. Incremental Excess Cancer Risks and Noncancer Hazards, Groundwater Before Cleanup[a]

Reuse Area	Exposure Scenario	Cancer Risk	Hazard Index
Breathing Indoor Air from A-Aquifer Groundwater			
MU-1	Residential	2 in 1,000	11
MU-2	Residential	1 in 1,000	4.6
MU-3	Residential	8 in 100,000	2.9
Drinking of or Showering with B-Aquifer Groundwater[b]			
MU-1	Residential	--	--
MU-2	Residential	4 in 10,000	2.5
MU-3	Residential	--	--

Notes:

a = Listed risk value is maximum incremental risk in Parcel E; risk is based on conditions before cleanup.

b = B-aquifer groundwater has a moderate potential to be used as a future drinking water source but is subject to local regulatory controls (as described in Section 2.2).

EOS = Parcel E open space (reuse area) MU = multi-use (reuse area) -- = not applicable (i.e., no chemicals of concern in the reuse area)

2.5.2. Ecological Risk Assessment

The Navy performed a **baseline ecological risk assessment**(27) (BERA) for soil and a **screening-level ecological risk assessment**(28) (SLERA) for shoreline sediment to evaluate risks to wildlife (such as small mammals, birds, and marine life) from exposure to soil and sediment. In addition, the Navy performed a SLERA to evaluate **risks to aquatic wildlife**(29) from exposure to potentially contaminated groundwater at Parcel E.

2.5.2.1. BERA for Soil

The BERA compared soil data against toxicity benchmarks for selected ecological receptors. Results of the risk evaluation indicated carnivorous birds (such as the American kestrel) and small omnivorous mammals (such as the house mouse) may be at risk from ingested doses of copper, lead, and PCBs at Parcel E. However, the magnitude of the hazard quotient (HQ) (all less than 2.7) and the low quality of the habitat at Parcel E suggests that risk is neither immediate nor severe.

2.5.2.2. SLERA for Shoreline Sediment

The SLERA for shoreline sediment evaluated whether or not chemicals detected along the shoreline pose an ecological risk to those receptors exposed to the narrow intertidal zone. All chemicals detected in shoreline sediment samples were screened to identify chemicals of potential ecological concern (COPECs). A toxicity-based approach was used to identify site-related chemicals that may pose risks to sensitive ecological receptors, including benthic invertebrates, birds, and mammals. Ingested doses were estimated for three birds (willet, surf scoter, and red tailed-hawk) and one mammal (house mouse). The SLERA identified the following COECs in shoreline sediment:

- Benthic invertebrates: copper, lead, mercury, zinc, PCBs, and DDT
- Birds (willet, surf scoter, and red tailed-hawk): PCBs
- Mammals (house mouse): cadmium, copper, molybdenum, zinc, and PCBs

2.5.2.3. Risk Evaluation of Groundwater

The SLERA evaluated potential risks to aquatic wildlife from exposure to contaminated groundwater at Parcel E. Chemical concentrations in groundwater were screened against the assigned aquatic evaluation criteria, mainly comprising saltwater aquatic criteria, to identify COPECs for surface water quality. Site-specific data for select COPECs were then evaluated against **trigger levels**(30)[9], consistent with the methods used in recent FS reports at other HPNS parcels, to further confirm if the COPECs needed to be addressed in remedial alternatives. Based on concentrations exceeding trigger levels (as adjusted based on ambient

[9] Trigger levels were developed (in the FS Report for Parcel E) for specific groundwater plumes by applying attenuation factors to pertinent surface water quality criteria (as identified in pertinent surface water ARARs and, for select metals, adjusted for ambient levels). The attenuation factors vary based on several parameters (most notably, width of the contaminant plume and distance to the bay) and provide a conservative estimate of the advection and dispersion that reduces chemical concentrations as groundwater moves from an inland location to San Francisco Bay. Further information on the development of trigger levels is provided in the hyperlinked reference document (Attachment 2).

levels), the following chemicals (or groups of chemicals) pose a potential risk to aquatic wildlife exposed to contaminated groundwater at Parcel E:

- Metals: arsenic, copper, lead, nickel, and zinc
- PCBs and pesticides: Aroclor-1254, Aroclor-1260, 4,4'-dichlorodiphenyldichloroethene (DDE), and alpha-chlordane
- Total TPH: sum of detected concentrations of all TPH ranges (gasoline-range, diesel-range, and motor-oil range)

Figure 8 identifies the groundwater plumes where these chemicals are present at concentrations exceeding the corresponding trigger levels (as adjusted based on ambient levels). Two additional groundwater plumes, which contained metals, were identified at IR-05 and IR-12; however, groundwater concentrations at these plumes did not exceed the corresponding trigger levels, thus the plumes did not require further evaluation in the FS Report.

2.5.3. Basis for Response Action

The response actions selected in this ROD are necessary to protect the public health, welfare, or the environment from actual or potential releases of hazardous substances into the environment. The Navy, in partnership with EPA, DTSC, and the Water Board, considered all pertinent factors in accordance with CERCLA and NCP remedy selection criteria and determined that remedial action is necessary to clean up soil, shoreline sediment, groundwater, and radiologically impacted media (including soil, shoreline sediment, and structures) at Parcel E. In addition, remedial action is necessary to control the NAPL contaminant source at IR-03. This determination was made because:

- Based on the HHRA results for **nonradioactive chemicals in soil**(31), shoreline sediment, and **groundwater**(32), incremental excess cancer risks exceed 1 in 1,000,000 and noncancer hazards were greater than 1 (see Tables 2 and 3).
- Incremental excess cancer risks from exposure to radionuclides in soil exceed 1 in 1,000,000 (see Table 2).
- Based on the **SLERA results**(33), chemical concentrations in shoreline sediment and groundwater in Parcel E pose a potential threat to wildlife.

The HHRA identified numerous nonradioactive COCs in soil present at concentrations that posed an unacceptable excess cancer risk or noncancer hazard (based on an evaluation of incremental risk). The elevated concentrations of several COCs (most notably arsenic, polycyclic aromatic hydrocarbons, and PCBs) were found to be dispersed over the different reuse areas at Parcel E. The widespread extent of these COCs prompted the Navy to consider a combination of removal and containment options in developing potential response actions. Specifically, the Navy identified an approach that proposed removal of the soil areas that posed the most significant risk to humans, and proposed containment for the remaining soil areas that posed a lower risk to humans.

In identifying potential soil areas for removal, the Navy focused the list of COCs to those nonradioactive chemicals present at concentrations that exceeded the **remediation goals**(34), which generally correspond to an excess cancer risk of 1 in 1,000,000 or a noncancer HI of 1 (based on an evaluation of incremental risk), by a factor of at least 5 (these areas are referred to as Tier 1 and Tier 2 locations). Tier 1 locations contain COCs at concentrations greater than 10 times the remediation goals. Tier 2 locations contain COCs at concentrations greater than 5 times the remediation goals. Tier 1 and Tier 2 locations contain elevated concentrations of nonradioactive COCs that pose the most significant risk to humans. Figure 10 on page 2-24 identifies the Tier 1 and Tier 2 locations, as well as TPH locations that contain TPH (commingled with CERCLA-regulated chemicals) at concentrations exceeding the petroleum source criterion (3,500 mg/kg). Figure 10 also identifies an area, adjacent to the shoreline in the northwest portion of Parcel E, where the Navy is conducting a soil investigation that may identify additional Tier 1, Tier 2, and TPH locations. In addition, Figure 10 highlights Building 406 and a portion of IR-04, which contain elevated concentrations of VOCs in soil gas that pose a potential risk to humans.

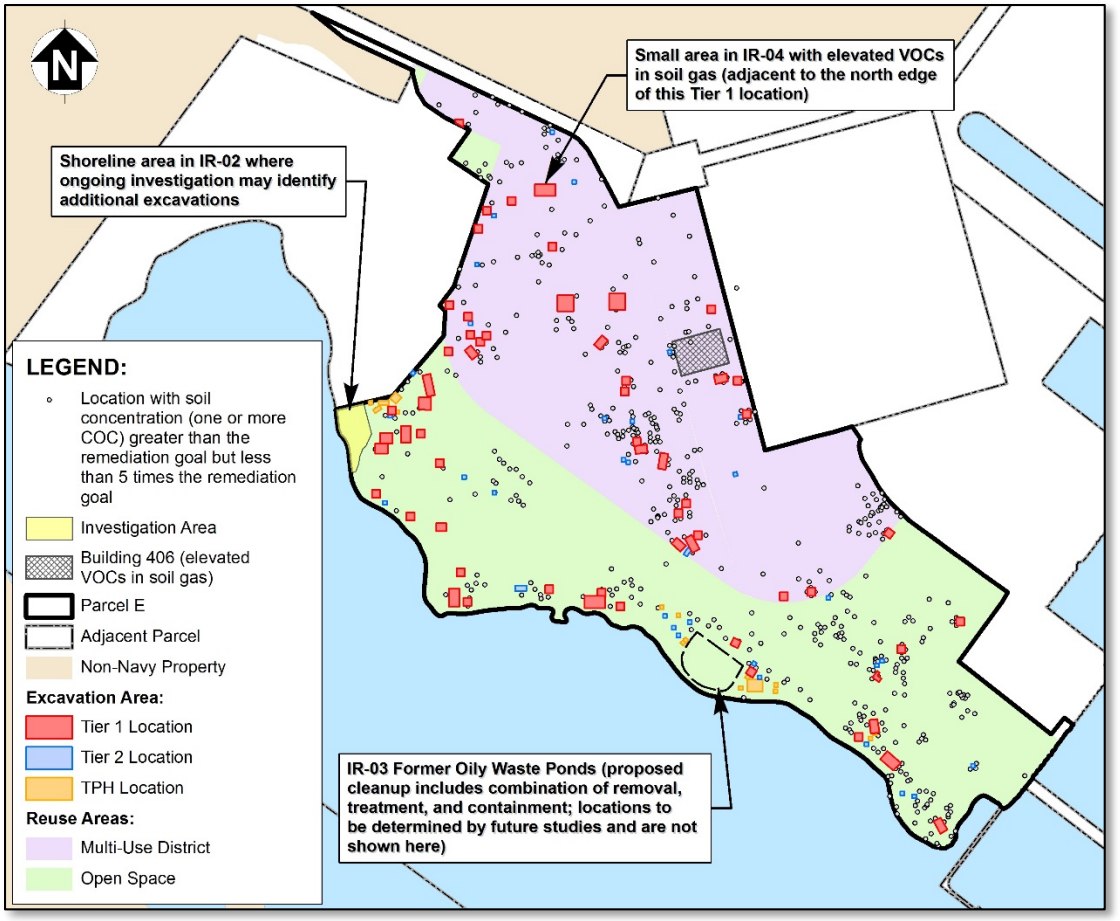

Figure 10. Tier 1, Tier 2, and TPH Locations in Soil

Table 4 identifies the COCs at the Tier 1 and Tier 2 locations, along with the soil remediation goals and soil action levels for each COC (i.e., corresponding to five times the remediation goal).

Table 4. Chemicals of Concern at Tier 1 and Tier 2 Locations

Reuse Area	COCs	Soil Remediation Goal[a] (mg/kg)	Soil Action Level[b] (mg/kg)
Open Space (EOS-1 through EOS-5)	Aroclor-1254	0.74	3.7
	Aroclor-1260	0.74	3.7
	Arsenic	11.1	55.5
	Benzo(a)anthracene	1.3	6.5
	Benzo(a)pyrene	0.33	1.7
	Benzo(b)fluoranthene	1.3	6.5
	Benzo(k)fluoranthene	1.3	6.5
	Chrysene	13	65
	Copper[c]	470[c]	2,350[d]
	Dibenz(a,h)anthracene	0.33	1.7
	Dieldrin	0.12	0.59
	Heptachlor epoxide	0.21	1.1
	Indeno(1,2,3-cd)pyrene	1.3	6.5
	Lead	155	775
	Manganese	2,430	12,200
	Zinc[c]	719[c]	3,600[d]
Mixed Used (MU-1 through MU-3)	3,3-Dichlorobenzidine	0.008	0.04
	Alpha-BHC	0.0019	0.010
	Antimony	10	50
	Aroclor-1254	0.093	0.47
	Aroclor-1260	0.21	1.1
	Arsenic	11.1	55.5
	Benzo(a)anthracene	0.37	1.9
	Benzo(a)pyrene	0.33	1.7
	Benzo(b)fluoranthene	0.34	1.7
	Benzo(k)fluoranthene	0.34	1.7
	Bis(2-ethylhexyl)phthalate	1.1	5.5
	Cadmium	3.5	18
	Copper	160	800
	Dibenz(a,h)anthracene	0.33	1.7
	Heptachlor epoxide	0.00054	0.0027

Table 4. Chemicals of Concern at Tier 1 and Tier 2 Locations *(continued)*

Reuse Area	COCs	Soil Remediation Goal[a] (mg/kg)	Soil Action Level[b] (mg/kg)
Mixed Used (MU-1 through MU-3) *(cont.)*	Indeno(1,2,3-cd)pyrene	0.35	1.8
	Lead	155	775
	Mercury	2.28	11.4
	Naphthalene	1.7	8.5
	Vanadium	117.2	586
	Zinc	370	1,850

Notes:

a = Remediation goals for recreational exposure scenario (associated with future open space areas) and residential exposure scenario (associated with future mixed use areas) are detailed in Table 5. Although not listed in this table, the total TPH remediation goal (3,500 mg/kg) is used to identify TPH locations that are a potential source to groundwater contamination.

b = The soil action level for each COC is equal to five times the corresponding remediation goal. Tier 1 and Tier 2 locations contain COCs at concentrations greater than the soil action levels.

c = Remediation goals for copper and zinc (in open space reuse areas EOS-1 through EOS-5) are based on **PSCs**(35) for terrestrial wildlife. Although copper and zinc are not COCs for the recreational exposure scenario, ecological benchmarks for these chemicals are being considered during response actions to address risk from the COCs identified in the human health risk assessment.

d = Soil action levels for copper and zinc are based on PSCs for terrestrial wildlife. Soil action levels for these metals are 5 times the PSC. Excavation of soil with concentrations exceeding these soil actions levels will reduce potential sources to groundwater contamination because copper and zinc are present in groundwater in select areas at concentrations that pose a risk to aquatic life in the bay.

bgs = below ground surface
BHC = benzene hexachloride
COC = chemical of concern
mg/kg = milligrams per kilogram
PSCs = protective soil concentrations
TPH = total petroleum hydrocarbons

In developing the response actions for radiologically impacted media, the Navy considered the historical operations and the available data on the distribution of radioactivity. At most radiologically impacted sites at Parcel E, radioactive contamination is present in shallow soil and is the result of historical operations at buildings or open storage areas. At these types of sites, removal by excavation is considered a practical and cost-effective means of preventing unacceptable exposure to humans. However, the operational history at IR-02 and IR-03 involved historical filling with soil and construction debris and intermittent disposal of various shipyard wastes, including radiological devices, and required an evaluation of a combination of removal and containment. The Navy focused the removal of ROCs to the surface of IR-02 and IR-03 because these areas posed the most significant risk to future recreational users. Following cleanup of ROCs within 1 foot of the existing ground surface, a cover (comprising clean imported soil and geosynthetic material) and ICs would effectively prevent unacceptable exposures to remaining concentrations of ROCs.

The risk evaluations identified several groundwater plumes containing nonradioactive chemicals that pose a potential risk to either humans or aquatic wildlife in San Francisco Bay. Groundwater plumes containing VOCs pose a potential risk to humans and are located in the inland portions of Parcel E (see Figure 8). In evaluating potential response actions, the Navy determined that remedial action, in the form of active treatment and monitoring, is needed to address this potential risk to humans. Groundwater plumes containing metals, PCBs, and TPH pose a potential risk to aquatic wildlife and are located near the shoreline (see Figure 8). In evaluating potential response actions, the Navy determined that remedial action, in the form of source removal, containment, and monitoring, is needed to address this potential risk to aquatic

wildlife. Remedial action at the groundwater plumes will be further evaluated in the remedial design (RD) using results from the ongoing groundwater monitoring program.

2.6. PRINCIPAL THREAT WASTE

According to EPA's "Guide to Principal Threat and Low Level Threat Wastes," principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. The **potential principal threat wastes at Parcel E**(36) consist of trichloroethene (TCE) at Building 406 and NAPL at IR-03. Source materials at these locations have migrated to A-aquifer groundwater at concentrations that pose a potential risk to humans (from TCE at Building 406) or aquatic wildlife in San Francisco Bay (from NAPL at IR-03). To address this potentially significant risk, removal or treatment of these source materials was evaluated as a component of the remedial alternatives for these areas. However, as described in Section 2.3.3, the high viscosity of NAPL at IR-03 limits its mobility, which suggests that containment may be used at IR-03, in combination with removal and treatment, to address the potential risk associated with the NAPL source. Section 2.8 discusses the remedial alternatives specific to NAPL at IR-03.

2.7. REMEDIAL ACTION OBJECTIVES

RAOs(37) are established based on attainment of regulatory requirements, standards, and guidance; contaminated media; COCs and COECs; potential receptors and exposure scenarios; and human health and ecological risks. Ultimately, the success of a remedial action is measured by its ability to meet the RAOs. Planned future land use is an important component in developing RAOs, and the RAOs for Parcel E are based on the CCSF's planned use for each reuse area, which is considered the reasonable anticipated end use of the property.

The RAOs for Parcel E were developed in conjunction with the regulatory agencies and are listed below by medium of concern.

Soil, Soil Gas, and Shoreline Sediment RAOs

- Prevent exposure of humans to inorganic and organic chemicals in soil at concentrations exceeding the remediation goals (see Table 5) for the following exposure pathways:
  - Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 10 feet bgs by residents in areas zoned for mixed-use reuse
  - Ingestion of homegrown produce in native soil in areas zoned for mixed-use reuse
  - Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 2 feet bgs by recreational users in areas zoned for open space reuse
  - Ingestion of, outdoor inhalation of, and dermal exposure to soil from 0 to 10 feet bgs by construction workers in all areas

Table 5. Remediation Goals for Nonradioactive Chemicals in Soil

Chemical of Concern	Remediation Goal for Residential Exposure Scenario (mg/kg)	Remediation Goal for Recreational Exposure Scenario (mg/kg)	Remediation Goal for Construction Worker Exposure Scenario (mg/kg)
1,2,4-Trichlorobenzene	--	--	230
1,2,4-Trimethylbenzene	--	--	170
1,3,5-Trimethylbenzene	--	--	69
3,3'-Dichlorobenzidine	1.6	--	--
4-Nitrophenol	0.29	--	--
4,4'-DDD	2.1	--	--
4,4'-DDE	1.6	--	--
Aldrin	0.024	--	0.54
alpha-BHC	0.0019	--	--
Antimony	10	--	120
Aroclor-1248	--	--	2.1
Aroclor-1254	0.093	0.74	2.1
Aroclor-1260	0.21	0.74	2.1
Arsenic	11.1	11.1	11.1
Benzene	0.18	--	9.4
Benzo(a)anthracene	0.37	1.3	6.4
Benzo(a)pyrene	0.33	0.33	0.65
Benzo(b)fluoranthene	0.34	1.3	6.5
Benzo(k)fluoranthene	0.34	1.3	6.5
Bis(2-ethylhexyl)phthalate	1.1	--	--
Cadmium	3.5	--	--
Carbazole	2.2	--	--
Chrysene	--	13	--
Copper	160	470[a]	11,000
Dibenz(a,h)anthracene	0.33	0.33	1.1
Dieldrin	0.0033	0.12	--
Dioxins/furans (TEQ)[b]	--	--	0.000023
gamma-BHC	0.0026	--	--
Heptachlor epoxide	0.0017	0.21	--
Indeno(1,2,3-cd)pyrene	0.35	1.3	6.5
Iron	58,000	--	93,000
Lead	155	155	800

Table 5. Remediation Goals for Nonradioactive Chemicals in Soil *(continued)*

Chemical of Concern	Remediation Goal for Residential Exposure Scenario (mg/kg)	Remediation Goal for Recreational Exposure Scenario (mg/kg)	Remediation Goal for Construction Worker Exposure Scenario (mg/kg)
Manganese	1,431	2,430	6,900
Mercury	2.28	210	93
n-Nitroso-di-n-propylamine	0.33	0.33	1.3
n-Nitrosodiphenylamine	0.68	--	--
Naphthalene	1.7	--	75
Nickel	--	--	5,800
Pentachlorophenol	2.60	--	--
Thallium	5.0	--	--
Vanadium	117	--	310
Trichloroethene	2.9	--	--
Zinc	370	719[a]	--
Xylene	270	--	--
Total TPH [c]	3,500	3,500	3,500

Notes: The basis (risk-based or ambient level) for the remediation goals is presented in Section 3 of the Feasibility Study Report.

a = Remediation goals for copper and zinc (in open space reuse areas EOS-1 through EOS-5) are based on **protective soil concentrations**(35) for terrestrial wildlife. Although copper and zinc are not COCs for the recreational exposure scenario, ecological benchmarks for these chemicals are being considered during response actions to address risk from the COCs identified in the human health risk assessment.

b = Remediation goal for dioxins and furans is expressed as a TEQ, which is calculated by multiplying the concentration of each dioxin and furan congener by a toxicity equivalency factor established by the 2005 World Health Organization and based on each congener's toxicity relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin.

c = The total TPH remediation goal is based on the petroleum source criterion for HPNS

BHC = benzene hexachloride

COC = chemical of concern

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethene

mg/kg = milligrams per kilogram

TEQ = toxic equivalent quotient

TPH = total petroleum hydrocarbons

-- = not applicable (i.e., not a chemical of concern under the exposure scenario)

- Prevent exposure of humans to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. **Table 7 of the final soil gas memorandum**(38) lists risk-based action levels for various volatile chemicals, including SVOCs and pesticides, that may pose an unacceptable risk via indoor inhalation of vapors. These soil gas action levels will be used for an initial risk-based screening of data collected during a future soil gas survey (such as the survey to be performed at Building 406 and VOC groundwater plumes following active treatment). After the initial risk-based screening, areas with unacceptable risk will be further evaluated using location-specific data (i.e., physical characteristics of the soil) to assess potential exposures consistent with the most current State of California and EPA vapor intrusion guidance. In addition, risks and hazards at these areas will be further characterized using the accepted methodology for risk assessments at HPNS. Section 2.9.2.1 provides additional information on the future soil gas survey and potential actions that may be prompted based on the results of the risk and hazard evaluation.
- Prevent exposure of humans to COCs in shoreline sediment at concentrations exceeding the remediation goals in Table 6.
- Prevent exposure of benthic invertebrates, birds, and mammals to COECs in shoreline sediment at concentrations exceeding the remediation goals in Table 6.

Table 6. Remediation Goals for COECs and COCs in Shoreline Sediment

COEC/COC	Remediation Goal (mg/kg)
Cadmium	3.14
Copper	124
Lead	218
Mercury	2.28
Molybdenum	2.68
Zinc	158
Total DDT	0.0461
Total Aroclors (PCBs)	0.2

Notes:
COC = chemical of concern
COEC = chemical of ecological concern
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligram per kilogram
PCBs = polychlorinated biphenyls

The RAOs for soil and shoreline sediment would be satisfied through actions involving removal, containment, monitoring, and ICs. The RAO for soil gas would be satisfied through actions involving active treatment (at Building 406 and other VOC groundwater plumes at Parcel E), monitoring, and ICs. Active treatment of soil gas would be performed at Building 406 until soil gas action levels are achieved or until systematic asymptotic conditions are reached without reasonable indication of further reduction based on system monitoring results. Active treatment of VOC groundwater plumes would also be performed to address unacceptable risk via indoor inhalation of vapors, and would be supplemented with monitored

natural attenuation (MNA) to ensure that natural processes are degrading the remaining VOCs. Section 2.9.2 provides further information on the actions required to satisfy the RAOs for soil, soil gas, and shoreline sediment.

Groundwater RAOs

- Prevent or minimize exposure of construction worker to VOCs in A-aquifer groundwater by dermal exposure and inhalation of vapors with chemicals exceeding remediation goals (Table 7).
- Prevent or minimize exposure of humans to COCs in the B-aquifer at concentrations exceeding remediation goals (Table 7) via the domestic use pathway.
- Prevent or minimize migration of arsenic, copper, lead, nickel, zinc, Aroclor-1254, Aroclor-1260, alpha-chlordane, and 4,4'-DDE to prevent discharge (into San Francisco Bay) that would result in concentrations exceeding corresponding **surface water quality criteria for aquatic wildlife**(39)[10].
- Prevent or minimize migration of A-aquifer groundwater containing total TPH concentrations greater than 1,400 micrograms per liter (µg/L) (where commingled with CERCLA-regulated substances) into San Francisco Bay.

Table 7. Remediation Goals for Groundwater

Exposure Scenario	Chemical of Concern	Plume/Exposure Area	Remediation Goal (µg/L)
Construction Worker Exposure to A-Aquifer Groundwater	1,2-Dichloroethene (total)	▪ Building 406 VOC Plume	270[a]
	1,4-Dichlorobenzene	▪ IR-03 Plume ▪ IR-04/IR-12 VOC Plume	52[a]
	Arsenic	▪ IR-02 Central Nickel Plume ▪ IR-02 Northwest Metals Plume ▪ IR-03 Plume ▪ IR-04/IR-12 VOC Plume	39
	Benzo(a)anthracene	▪ IR-03 Plume	0.65
	Benzo(a)pyrene	▪ IR-03 Plume	0.05
	Benzo(b)fluoranthene	▪ IR-03 Plume	0.45
	Chrysene	▪ IR-03 Plume ▪ IR-04/IR-12 VOC Plume	6.7
	Indeno(1,2,3-cd)pyrene	▪ IR-03 Plume	0.31
	Naphthalene	▪ IR-03 Plume ▪ IR-04/IR-12 VOC Plume	16[a]
	Pentachlorophenol	▪ IR-04/IR-12 VOC Plume	50
	Tetrachloroethene	▪ IR-04/IR-12 VOC Plume	18[b]
	Trichloroethene	▪ Building 406 VOC Plume	290[a]
	Vinyl chloride	▪ Building 406 VOC Plume	5.4[a]

[10] This evaluation should not be interpreted to state or imply that surface water ARARs such as the California Toxics Rule are ARARs for in-situ groundwater. Surface water ARARs apply to surface waters.

Table 7. Remediation Goals for Groundwater *(continued)*

Exposure Scenario	Chemical of Concern	Plume/Exposure Area	Remediation Goal (µg/L)
Domestic Use Exposure to B-Aquifer Groundwater	1,1- Dichloroethene	▪ IR-03 Plume ▪ Building 406 VOC Plume	6[b]
	cis-1,2- Dichloroethene	▪ IR-03 Plume ▪ Building 406 VOC Plume	6[b]
	trans-1,2- Dichloroethene	▪ IR-03 Plume ▪ Building 406 VOC Plume	10[b]
	1,4-Dichlorobenzene	▪ IR-03 Plume ▪ Building 406 VOC Plume	5
	Arsenic	▪ IR-02 Northwest Metals Plume ▪ IR-03 Plume ▪ Building 406 VOC Plume	27.3
	Manganese	▪ IR-02 Northwest Metals Plume ▪ IR-03 Plume ▪ Building 406 VOC Plume	8,140
	Tetrachloroethene	▪ IR-03 Plume ▪ Building 406 VOC Plume	5
	Thallium	▪ Building 406 VOC Plume	12.97
	Trichloroethene	▪ IR-03 Plume ▪ Building 406 VOC Plume	5
	Vinyl chloride	▪ IR-03 Plume ▪ Building 406 VOC Plume	0.5
Aquatic Wildlife Exposure to A-Aquifer Groundwater	Total TPH (goals vary based on distance from the bay)[c]	▪ IR-03 Plume	1,400 to 20,000

Notes: The basis (risk-based, regulatory limit, or ambient level) for the remediation goals is presented in Section 3 of the FS Report (unless otherwise noted).

a = The remediation goals for select chemicals were revised (i.e., reduced slightly relative to the risk-based criteria in the FS Report) to ensure consistency with the ROD for HPNS Parcel C.

b = Remediation goals for select VOCs were added to this ROD because of their relationship to other VOCs (e.g., 1,1-dichloroethene and 1,2-dichloroethene are degradation products of trichloroethene) that were identified as chemicals of concern in the FS Report. The remediation goal for tetrachloroethene in A-aquifer groundwater is based on the risk-based criteria presented in the ROD for HPNS Parcel C. The remediation goals for 1,1-dichloroethene and 1,2-dichloroethene in B-aquifer groundwater are based on the State of California maximum contaminant limits.

c = The distance-based TPH criteria are as follows:

Distance from shoreline (feet)	Total TPH (µg/L)	Distance from shoreline (feet)	Total TPH (µg/L)
0–<25	1,400	125–<150	6,949
25–<50	1,467	150–<175	9,539
50–<75	2,092	175–<200	12,604
75–<100	3,216	200–<225	16,145
100–<125	4,839	≥225	20,000

HPNS = Hunters Point Naval Shipyard
IR = Installation Restoration
ROD = record of decision
TPH = total petroleum hydrocarbons
VOC = volatile organic compound
µg/L = micrograms per liter

The RAOs for groundwater would be satisfied through actions involving treatment, containment, monitoring, and ICs. As described previously, active treatment and MNA of VOC groundwater plumes would be performed to address unacceptable risk via indoor inhalation of vapors. Actions and decisions to address the indoor inhalation of vapors will be based on soil gas data and the soil gas action levels. Section 2.9.2 provides further information on the actions required to satisfy the RAOs for groundwater.

RAOs for NAPL at IR-03 (Former Oily Waste Ponds)

- Prevent or minimize migration of NAPL to prevent discharge that would result in COEC concentrations greater than the **surface water quality criteria for aquatic wildlife**(39)[9].
- Prevent or minimize migration of NAPL to prevent discharge that would result in total TPH groundwater concentrations greater than 1,400 µg/L into San Francisco Bay.

The COCs and COECs in soil, soil gas, shoreline sediment, and groundwater at IR-03 would be subject to the pertinent RAOs, as previously described. The RAOs for NAPL at IR-03 would be satisfied through actions involving removal, treatment, containment, monitoring, and ICs. In addition, active treatment of remaining contaminants in groundwater (following removal or treatment of NAPL) would also be performed to ensure compliance with the pertinent groundwater RAOs (regarding discharge of contaminants into San Francisco Bay). The active treatment would be supplemented with MNA to ensure that natural processes are degrading the remaining VOCs and TPH. Section 2.9.2 provides further information on the actions required to satisfy the RAOs for NAPL at IR-03.

Radiological RAO for Radiologically Impacted Media (soil, shoreline sediment, and structures)

- Prevent exposure to ROCs at activity levels that exceed remediation goals (see Table 8) for all potentially complete exposure pathways (which include external exposure, ingestion, and inhalation of soil based on the **CSM for human health**(18)).

Table 8. Remediation Goals for Radionuclides

Radionuclide	Soil and Sediment[a] (pCi/g)[a]		Surfaces	
	Industrial Worker	Residential	Equipment, Waste (dpm/100 cm²)	Structures (dpm/100 cm²)
Americium-241	5.67	1.36	100	100
Cesium-137	0.113	0.113	5,000	5,000
Cobalt-60	0.252[b]	0.252[b]	5,000	5,000
Plutonium-239	14.0	2.59	100	100
Radium-226	1.0[c]	1.0[c]	100	100

Table 8. Remediation Goals for Radionuclides *(continued)*

Radionuclide	Soil and Sediment[a] (pCi/g)[a]		Surfaces	
	Industrial Worker	Residential	Equipment, Waste (dpm/100 cm^2)	Structures (dpm/100 cm^2)
Strontium-90	10.8	0.331	1,000	1,000
Uranium-235	0.398	0.195	5,000	488

Notes: The basis (risk-based) for the RGs is presented in Section 3 of the radiological addendum to the FS Report.

a = RGs for two future use scenarios; however, the residential RGs will apply in all Parcel E areas. These more conservative RGs will enhance the protectiveness of the remedial action for Parcel E, particularly as it relates to future property transfer and the potential need to apply institutional controls for radionuclides.

b = RG for Cobalt-60 was revised to support efficient laboratory gamma spectroscopy analysis of soil samples. This revised RG maintains morbidity risks within the U.S. Environmental Protection Agency-defined acceptable range and permits an exposure level that does not increase the risk of cancer from a potential exposure to Cobalt-60.

c = Objective is 1 pCi/g above background per agreement with U.S. Environmental Protection Agency (established in "Final Basewide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California," dated April 21, 2006). The Radium-226 background level for surface soil is 0.633 pCi/g. The Radium-226 background level for storm drain and sewer lines is 0.485 pCi/g.

dpm/100 cm^2 = disintegrations per minute per 100 square centimeters

pCi/g = picocurie per gram

RG = remediation goal

The RAO for radiologically impacted media outside of IR-02 and IR-03 would be satisfied through actions involving removal. The RAO for radiologically impacted media within IR-02 and IR-03 would be satisfied through actions involving a combination of removal, containment, monitoring/maintenance, and ICs. The RAO for radiologically impacted media does not pertain to groundwater because, as described in Section 2.3.4, previous investigations have not identified radionuclides in groundwater at activity levels that warrant remedial action. However, the selected remedy at IR-02 and IR-03 includes future monitoring to demonstrate, consistent with the findings of previous radiological investigations, that radionuclides are not present in groundwater at activity levels that are both statistically significant and pose an unacceptable risk to human health and the environment. The determination of statistical significance will be made in accordance with the substantive provisions of Title 22 California Code of Regulations § 66264.98(i). The duration of the groundwater monitoring for radionuclides will be determined in accordance with Title 22 California Code of Regulations § 66264.90(c). Section 2.9.2 provides further information on the actions required to satisfy the RAOs for radiologically impacted media.

Table 5 lists the remediation goals for COCs and COECs in soil. Table 6 lists the remediation goals for COCs and COECs in shoreline sediment. Table 7 lists the remediation goals for COCs in groundwater. Table 8 the remediation goals for ROCs in radiologically impacted media. Remediation goals were not developed for COECs in groundwater because, except for total TPH, the water quality criteria referenced in the groundwater and NAPL RAOs are based on standards for aquatic wildlife in San Francisco Bay, apply to surface water at the interface of A-aquifer groundwater, and do not apply to in-situ A-aquifer groundwater at Parcel E. Plume-specific **trigger levels**$_{(30)}$[11] will be used as groundwater monitoring criteria

[11] Trigger levels were developed (in the FS Report for Parcel E) for specific groundwater plumes by applying attenuation factors to pertinent surface water quality criteria (as identified in pertinent surface water ARARs and, for select metals, adjusted for ambient levels). The attenuation factors vary based on several parameters (most notably, width of the contaminant plume and distance to the bay) and provide a conservative estimate of the advection and dispersion that reduces chemical concentrations as groundwater moves from an inland location to San Francisco Bay. Further information on the development of trigger levels is provided in the hyperlinked reference document (Attachment 2).

to evaluate the potential risk to aquatic wildlife in San Francisco Bay, but the RD may develop alternative monitoring criteria (using refined fate and transport modeling) to more rigorously assess the groundwater-to-surface water transport mechanism.

2.8. DESCRIPTION AND EVALUATION OF REMEDIAL ALTERNATIVES

The Navy screened a range of **general response actions and remedial technologies**(40) and used the retained technologies to develop alternatives in the FS to address contamination at Parcel E. In developing the remedial alternatives, the Navy evaluated site conditions and used experience and engineering judgment to formulate process options into the most plausible site-specific response actions. Remedial alternatives were developed and evaluated for the following contaminated media and source areas:

- Soil and shoreline sediment contaminated with nonradioactive chemicals
- Groundwater contaminated with nonradioactive chemicals
- NAPL contaminant source at IR-03
- Radiologically-impacted media (including soil, shoreline sediment, and structures)

Section 2.8.1 describes the remedial alternatives, and Section 2.8.2 presents the results of the Navy's comparative analysis (performed in accordance with the NCP).

2.8.1. Description of Remedial Alternatives

Table 9 presents the major components, details, and cost of each remedial alternative identified for soil and shoreline sediment, groundwater, NAPL at IR-03, and radiologically impacted media. The costs shown in Table 9 are from the Final FS Report for the combined Parcels E and UC-3. No adjustments were made to this original cost analysis because Parcel UC-3 represents a negligible portion of the combined parcels (less than 1 percent for the soil alternatives and between 4 and 6 percent for the groundwater alternatives). Thus, the original cost estimate is valid for Parcel E.

Table 9. Remedial Alternatives for Parcel E

Remedial Alternative	Approximate Cost[12]	Components of Remedial Alternative
Soil and Shoreline Sediment Contaminated with Nonradioactive Chemicals		
S-1	$0M	No Action: No actions or costs; this alternative is required by CERCLA as a baseline for comparison with the other alternatives.
S-2	**Capital Cost: $24.6M(41)** Total O&M Cost: $8.4M Present-Worth Cost: $35.2M (2.7% discount rate) Timeframe: 32 years	Covers: Construct physical barriers to prevent exposure to remaining contaminants in soil and shoreline sediment at Parcel E. Shoreline Protection: Construct shoreline protection features to prevent contaminated shoreline sediment and onshore soil from entering San Francisco Bay and to integrate with the proposed surface covers. Long-Term Monitoring and Maintenance: Regularly inspect, maintain, and repair the existing covers and shoreline protection. ICs: Impose ICs to limit the use of land or restrict activities that take place within an area.
S-3	**Capital Cost: $36.1M(42)** Total O&M Cost: $8.3M Present-Worth Cost: $48.7M (2.7% discount rate) Timeframe: 32 years	*All of the same elements as Alternative S-2, but would also include:* Excavation and Offsite Disposal of Tier 1 Locations: Remove Tier 1 locations that contain chemicals in soil at concentrations greater than 10 times the remediation goals and locations that contain TPH at concentrations greater than the remediation goals; covers and ICs to address remaining low-risk contaminated soil.
S-4	**Capital Cost: $37.3M(43)** Total O&M Cost: $8.3M Present-Worth Cost: $50.2M (2.7% discount rate) Timeframe: 32 years	*All of the same elements as Alternative S-3, but would also include:* Excavation and Offsite Disposal of Tier 2 Locations: Remove Tier 2 locations that contain chemicals in soil at concentrations greater than 5 times the remediation goals; covers and ICs to address remaining low-risk contaminated soil. SVE: Perform SVE to address VOC soil contamination associated with Building 406 TCE plume.
Groundwater Contaminated with Nonradioactive Chemicals		
GW-1	$0M	No Action: No actions or costs; this alternative is required by CERCLA as a baseline for comparison with the other alternatives.
GW-2	**Capital Cost: $0.28M(44)** Total O&M Cost: $2.9M Present-Worth Cost: $2.6M (2.7% discount rate) Timeframe: 32 years	Groundwater Monitoring: Implement long-term monitoring of groundwater to assess whether chemicals are migrating and to monitor changes in ambient conditions. ICs: Impose ICs to limit the use of land or restrict activities that take place within an area.

[12] The approximate costs are consistent with the estimates provided in the Final FS Report for Parcel E and include small amounts attributed to implementation of the soil and groundwater alternatives at Parcel UC-3 (which was part of Parcel E at the time the FS Report was published). The approximate costs were not adjusted in this ROD to maintain consistency with the FS Report and because the proportion of these cost attributed to the soil and groundwater alternatives at Parcel UC-3 is very small (around 1 percent for the soil alternatives and between 4 and 6 percent for the groundwater alternatives).

Table 9. Remedial Alternatives for Parcel E *(continued)*

Remedial Alternative	Approximate Cost[12]	Components of Remedial Alternative
Groundwater Contaminated with Nonradioactive Chemicals (continued)		
GW-3	**Capital Cost: $1.2M(45)** Total O&M Cost: $3.8M Present-Worth Cost: $4.5M (2.7% discount rate) Timeframe: 32 years	*All of the same elements as Alternative GW-2, but would also include:* Groundwater Containment: Build below-ground barrier to limit groundwater flow from nearshore contaminant plumes (with PCBs and metals) into San Francisco Bay. In-Situ Groundwater Treatment: Inject an organic compound (biological nutrients) at the source of groundwater contamination to stimulate biological activity to create conditions where VOCs are destroyed in groundwater. If determined necessary in the remedial design, a more aggressive form of in-situ treatment may be performed at the Building 406 TCE plume. This option would consist of injecting zero-valent iron (potentially mixed with biological nutrients) at the source of groundwater contamination to create conditions where VOCs are destroyed in groundwater. Monitored Natural Attenuation: Implement long-term monitoring and studies of groundwater to assess whether chemicals are migrating and to evaluate the effects of treatment.
GW-4	**Capital Cost: $2.0M(46)** Total O&M Cost: $4.2M Present-Worth Cost: $5.9M (2.7% discount rate) Timeframe: 32 years	*All of the same elements as Alternative GW-3, but would include a different treatment technology for the Building 406 TCE plume:* Air Sparging: Perform a more aggressive form of in-situ treatment at the Building 406 TCE plume, consisting of injecting air under high pressure at the source of groundwater contamination to create conditions where VOCs are stripped from groundwater, captured by SVE wells, and treated above the ground prior to discharge to the atmosphere. SVE: Perform SVE to address VOC soil contamination associated with Building 406 TCE plume.
NAPL Contaminant Source at Former Oily Waste Ponds (IR-03)		
O-1	$0M	No Action: No actions or costs; this alternative is required by CERCLA as a baseline for comparison with the other alternatives.
O-2	**Capital Cost: $1.1M(47)** Total O&M Cost: $0.43M Present-Worth Cost: $1.7M (2.7% discount rate) Timeframe: 31 years	Source Containment: Construct surface cover to prevent exposure to remaining contaminants and limit groundwater infiltration, and build below-ground barrier to limit groundwater flow from the contaminant plume into the bay. Groundwater Monitoring: Implement long-term monitoring of groundwater to assess whether chemicals are migrating and to monitor changes in ambient conditions. ICs: Impose ICs to limit the use of land or restrict activities that take place within an area.

Table 9. Remedial Alternatives for Parcel E *(continued)*

Remedial Alternative	Approximate Cost[12]	Components of Remedial Alternative
NAPL Contaminant Source at Former Oily Waste Ponds (IR-03) (continued)		
O-3	**Capital Cost: $11.2M(48)** Total O&M Cost: $0.59M Present-Worth Cost: $13.1M (2.7% discount rate) Timeframe: 34 years	*All of the same elements as Alternative O-2, but would also include:* Source Removal or Treatment: Perform a combination of several technologies to remove or treat the NAPL contaminant source (future studies would help identify the specific combination of technologies, which may include excavation and offsite disposal, in-situ stabilization/solidification, and thermally-enhanced extraction). Monitored Natural Attenuation: Implement long-term monitoring and studies of groundwater to assess whether chemicals are migrating and to evaluate the effects of treatment.
O-4	**Capital Cost: $12.5M(49)** Total O&M Cost: $0.90M Present-Worth Cost: $14.7M (2.7% discount rate) Timeframe: 35 years	*All of the same elements as Alternative O-3, but would also include:* In-Situ Groundwater Treatment: Inject an organic compound at the source of groundwater contamination to stimulate biological activity to create conditions where contaminants are destroyed in groundwater. If thermally-enhanced extraction is used over a large area (to be determined in the remedial design), then a more aggressive form of in-situ treatment involving heating the groundwater might be implemented. This option would involve heating the groundwater to boiling temperature to create conditions where contaminants are stripped from groundwater, captured by SVE wells, and treated above the ground prior to discharge to the atmosphere.
O-5	**Capital Cost: $18.7M(50)** Total O&M Cost: $0.90M Present-Worth Cost: $22.0M (2.7% discount rate) Timeframe: 35 years	*All of the same elements as Alternative O-4, but would also include:* Excavation and Offsite Disposal of Shallow Contamination: Excavate the NAPL contaminant source above the groundwater table and dispose of the material at an offsite landfill; the NAPL contaminant source below the groundwater table would be addressed with a combination of several technologies (as identified for Alternative O-3).
O-6	**Capital Cost: $17.9M(51)** Total O&M Cost: $0.43M Present-Worth Cost: $21.8M (2.7% discount rate) Timeframe: 31years	Excavation and Offsite Disposal of Shallow and Deep Contamination: Excavate the NAPL contaminant source above and below the groundwater table and dispose of the material at an offsite landfill; monitored natural attenuation would be performed and ICs would be imposed (as identified for Alternative O-3) until groundwater concentrations meet remediation gorals.

Table 9. Remedial Alternatives for Parcel E *(continued)*

Remedial Alternative	Approximate Cost[12]	Components of Remedial Alternative
Radiologically Impacted Media		
R-1	$0M	No Action: No actions or costs; this alternative is required by CERCLA as a baseline for comparison with the other alternatives.
R-2	**Capital Cost: $29.5M(52)** Total O&M Cost: $0M[a] Present-Worth Cost: $34.9M (2.7% discount rate) Timeframe: 32 years	Scoping or Characterization Surveys: Perform scoping or characterization surveys to identify potential radioactive contamination requiring remediation. Soil, Sediment, or Debris Removal: Remove soil, sediment, or debris with radioactive contamination exceeding remediation goals and dispose of the waste at an offsite landfill, with soil excavation depth at IR-02 and IR-03 (where covers and ICs are proposed to address radioactive contamination) generally limited to the upper 1 foot. Structure Decontamination and Demolition: Remove building materials with radioactive contamination exceeding remediation goals and dispose of the debris at an offsite landfill, with specific decontamination or demolition approach varying depending on the extent of contamination and building type and size. Final Status Surveys: Perform final surveys to demonstrate that remediation goals have been met. Soil Cover, Shoreline Protection, and ICs (at IR-02 and IR-03): Following removal of radioactive contamination near the existing surface, construct a 2-foot-thick soil cover (with underlying demarcation layer) to prevent exposure to remaining contaminants and impose ICs to limit the use of land or restrict activities that take place within an area.
R-3	**Capital Cost: $30.5M(53)** Total O&M Cost: $0M[a] Present-Worth Cost: $36.1M (2.7% discount rate) Timeframe: 32 years	All of the same elements as Alternative R-2, with the addition of a thicker (3-foot) soil cover at IR-02 and IR-03 to provide additional shielding from residual radioactivity.

Notes:

a = The O&M activities associated with the radiological remedial alternatives are attributed to the soil cover, shoreline protection, and ICs at IR-02 and IR-03, and include inspection, landscaping maintenance, 5-year reviews, and IC implementation. However, these O&M activities are also required to implement the selected remedy for soil. Therefore, consistent with information presented in the Radiological Addendum to the FS Report, the costs associated with these O&M activities were evaluated in the FS Report as part of the analysis of the soil remedial alternatives.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
ICs = institutional controls
IR = Installation Restoration
NAPL = nonaqueous-phase liquid
O&M = operation and maintenance
SVE = soil vapor extraction
TCE = trichloroethene
TPH = total petroleum hydrocarbons
VOC = volatile organic compound

2.8.2. Comparative Analysis of Alternatives

A comparative analysis of alternatives with respect to the **nine evaluation criteria**(54) is provided below. Tables 10 through 13 provide a relative ranking of the alternatives for soil and shoreline sediment, groundwater, NAPL at IR-03, and radiologically impacted media, respectively. The results of the comparative analysis are briefly summarized on page 2-44.

Table 10. Relative Ranking of Remedial Alternatives for Soil and Shoreline Sediment

CERCLA Criteria	S-1 No Action	S-2 Covers, ICs, and Shoreline Protection	S-3 Excavation and Offsite Disposal of Tier 1 Locations, followed by Covers, ICs, and Shoreline Protection	S-4 Excavation and Offsite Disposal of Tier 1 and Tier 2 Locations, followed by Covers, SVE, ICs, and Shoreline Protection
Threshold Criteria				
Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes
Compliance with ARARs	N/A	Yes	Yes	Yes
Balancing Criteria				
Long-Term Effectiveness and Permanence				
Reduction in Toxicity, Mobility, or Volume Through Treatment				
Short-Term Effectiveness				
Implementability				
Present-Worth Cost ($M)	0	35.2	48.7	50.2
Modifying Criteria				
State Acceptance				
Community Acceptance				

Notes: Fill symbol by quarters from open (not acceptable) to full (excellent).

ARARs = applicable or relevant and appropriate requirements

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

ICs = institutional controls

SVE = soil vapor extraction

Table 11. Relative Ranking of Remedial Alternatives for Groundwater

CERCLA Criteria	GW-1 No Action	GW-2 ICs and Long-Term Groundwater Monitoring	GW-3 Groundwater Containment, In-Situ Treatment, MNA, and ICs	GW-4 Groundwater Containment, In-Situ Treatment, Air Sparging, MNA, and ICs
Threshold Criteria				
Overall Protection of Human Health and the Environment	No	No	Yes	Yes
Compliance with ARARs	N/A	No	Yes	Yes
Balancing Criteria				
Long-Term Effectiveness and Permanence				
Reduction in Toxicity, Mobility, or Volume Through Treatment				
Short-Term Effectiveness				
Implementability				
Present-Worth Cost ($M)	0	2.6	4.5	5.9
Modifying Criteria				
State Acceptance				
Community Acceptance				

Notes: Fill symbol by quarters from open (not acceptable) to full (excellent).

ARARs = applicable or relevant and appropriate requirements

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

ICs = institutional controls

MNA = monitored natural attenuation

Table 12. Relative Ranking of Remedial Alternatives for NAPL at IR-03

CERCLA Criteria	O-1 No Action	O-2 Source Containment, Long-Term Monitoring, and ICs	O-3 Source Removal or Treatment, Containment, MNA, and ICs	O-4 Source Removal or Treatment, In-Situ Groundwater Treatment, Containment, MNA, and ICs	O-5 Source Removal by Excavation and Extraction/ Treatment, In-Situ Groundwater Treatment, MNA, and ICs	O-6 Source Removal by Excavation, MNA, and ICs
Threshold Criteria						
Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes	Yes	Yes
Compliance with ARARs	N/A	Yes	Yes	Yes	Yes	Yes
Balancing Criteria						
Long-Term Effectiveness and Permanence						
Reduction in Toxicity, Mobility, or Volume Through Treatment						
Short-Term Effectiveness						
Implementability						
Present-Worth Cost ($M)	0	1.7	13.1	14.7	22.0	21.8
Modifying Criteria						
State Acceptance						
Community Acceptance						

Notes: Fill symbol by quarters from open (not acceptable) to full (excellent).

ARARs = applicable or relevant and appropriate requirements

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

NAPL = nonaqueous-phase liquid

ICs = institutional controls

MNA = monitored natural attenuation

Table 13. Relative Ranking of Remedial Alternatives for Radiologically Impacted Media

CERCLA Criteria	R-1 No Action	R-2 Survey, Removal, and Disposal (with 2-foot-thick soil cover and ICs at IR-02 and IR-03)	R-3 Survey, Removal, and Disposal (with 3-foot-thick soil cover and ICs at IR-02 and IR-03)
Threshold Criteria			
Overall Protection of Human Health and the Environment	No	Yes	Yes
Compliance with ARARs	N/A	Yes	Yes
Balancing Criteria			
Long-Term Effectiveness and Permanence			
Reduction in Toxicity, Mobility, or Volume Through Treatment			
Short-Term Effectiveness			
Implementability			
Present-Worth Cost ($M)	0	34.9	36.1
Modifying Criteria			
State Acceptance			
Community Acceptance			

Notes:

Fill symbol by quarters from open (not acceptable) to full (excellent).

ARARs = applicable or relevant and appropriate requirements

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

ICs = institutional controls

IR = Installation Restoration

Threshold Criteria

All alternatives, except for the no action alternatives (S-1, GW-1, O-1, and R-1) and Alternative GW-2, provide adequate protection of human health and the environment and comply with state and federal ARARs. Therefore, Alternatives S-2 through S-4, GW-3 and GW-4, O-2 through O-6, and R-2 and R-3 satisfy the two threshold criteria specified in the NCP and are eligible for selection as the final remedial action. The "no action" alternatives (S-1, GW-1, O-1, and R-1) and Alternative GW-2 would not provide adequate protection of human health and the environment and are not eligible for selection as the final remedial action.

Primary Balancing Criteria

Long-Term Effectiveness and Permanence. All alternatives, except for the no action alternatives (S-1, GW-1, O-1, and R-1) and Alternative GW-2, would be effective in the long-term. Of the soil alternatives, Alternative S-4 would be most effective in the long-term because the largest volume of soil contamination would be removed. Of the groundwater alternatives, Alternative GW-3 would be most effective in the long-term because it would use reliable and effective treatment technologies, as demonstrated by cleanup of groundwater at other HPNS parcels. Alternative GW-4 was rated slightly lower than Alternative GW-3 because the air sparging (proposed for the Building 406 TCE Plume) may be limited by the presence of heterogeneous soil, which poses challenges in adequately capturing VOC emissions from the unsaturated zone. For contamination at IR-03 (the Former Oily Waste Ponds), Alternative O-6 would be most effective in the long-term because the largest volume of the NAPL contaminant source would be removed. For radiologically impacted media at Parcel E, Alternatives R-2 and R-3 would be equally effective in the long-term because residual radiological contamination would be removed and, for IR-02 and IR-03, the final soil cover would protect people and wildlife from being exposed to remaining contamination. The permanent features of each alternative (such as covers) would be maintained as long as contamination that could pose an unacceptable risk remains at the site.

Reduction in Toxicity, Mobility, or Volume through Treatment. The alternatives include varying levels of treatment to address contamination in soil and groundwater, as well as contamination at IR-03 (the Former Oily Waste Ponds). Alternatives S-4, GW-3, O-4, and O-5 provide the highest performance in the way they reduce the toxicity, mobility, and volume of contaminants through treatment. Alternative GW-4 was rated slightly lower than Alternative GW-3 because the air sparging (proposed for the Building 406 TCE Plume) may be limited by the presence of heterogeneous soil, which poses challenges in effectively removing and treating VOCs from groundwater. The alternatives for radiologically impacted media focus on removing and containing contaminants at Parcel E and do not involve a significant amount of treatment. Therefore, Alternatives R-2 and R-3 would perform equally in the minimal way they reduce the toxicity, mobility, and volume of radiological contaminants through treatment.

Short-Term Effectiveness, Implementability, and Cost. Alternatives involving more active cleanup (such as excavation) generally pose more short-term risks (to humans and the environment), are more difficult to carry out, and are more expensive. This finding is illustrated by the different ratings for Alternatives S-2 and S-4

(see Table 10). In addition, the Navy's evaluation identified major differences between Alternative O-6 and Alternatives O-2, O-3, and O-4 relative to short-term effectiveness, implementability, and cost. In comparison with Alternatives O-2, O-3, and O-4, Alternative O-6 presents more short-term risks (for example, increased risk of accidents for site workers), would be more difficult to carry out, and would cost more. The ratings for Alternative O-6 were based on several factors, the most significant being the deep excavation (potentially up to 35 feet) required to completely remove the NAPL contaminant source. Alternatives O-2, O-3, and O-4 present fewer short-term risks, would be easier to carry out, and would cost significantly less in comparison with Alternative O-6. Alternative O-2 would be the easiest and least expensive because it involves only containment, while Alternatives O-3 and O-4 balance ease of implementation and cost because they would involve removing or treating the NAPL contaminant source without major excavations. For the alternatives addressing radiologically impacted media, Alternative R-2 would be easier to carry out when compared with Alternative R-3 because the soil cover (over about 45 acres comprising IR-02 and IR-03) would be 2 feet thick instead of 3 feet thick.

Modifying Criteria

State Acceptance. State involvement has been solicited throughout the CERCLA process. The State of California concurs with the Navy's selected remedial alternatives (Alternatives S-4, GW-3, O-4, and R-2).

Community Acceptance. Community acceptance is evaluated based on comments received from the public during the public comment period for the Proposed Plan. The Proposed Plan, which identified Alternatives S-4, GW-3, O-4, and R-2 as the preferred remedial alternatives, was presented to the community and discussed during a public meeting on February 28, 2013. Comments were also gathered during the public comment period from February 13 through April 1, 2013. In general, public comments expressed support for the Navy's selected remedial alternatives. Attachment 3, the responsiveness summary, of this ROD addresses the public's comments and specific concerns about the selected remedial alternatives for NAPL at IR-03 (Alternative O-4) and radiologically impacted media at Parcel E (Alternative R-2). Section 2.10 provides additional information on the Navy's community participation efforts for Parcel E.

2.9. SELECTED REMEDY

2.9.1. Rationale for Selected Remedies

The selected remedies for Parcel E are:

- **Soil and Shoreline Sediment – Alternative S-4:** Excavation and Offsite Disposal of Tier 1 and Tier 2 Locations, followed by Covers, SVE, Institutional Controls, and Shoreline Protection
- **Groundwater – Alternative GW-3:** Groundwater Containment, In-Situ Treatment, MNA, and Institutional Controls

- **NAPL at IR-03 – Alternative O-4:** Source Removal or Treatment, In-Situ Groundwater Treatment, Containment, MNA, and Institutional Controls
- **Radiologically Impacted Media – Alternative R-2:** Survey, Removal, and Disposal (with 2-foot-thick soil cover and ICs at IR-02 and IR-03)

The remedies were selected based on an evaluation of the remedial alternatives, as described in Section 2.8, relative to the nine evaluation criteria. The selected remedies comply with the two threshold criteria and provide the best balance of tradeoffs with respect to the five balancing criteria. The Navy's evaluation of the two modifying criteria did not warrant changes to the preferred alternatives published in the Proposed Plan. The State of California, through DTSC and the Water Board, and segments of the community support Alternatives S-4, GW-3, O-4, and R-2. As detailed in Attachment 3, the information presented by members of the community that do not support the preferred alternatives does not justify modification of them, or selection of a different alternative, based upon the community acceptance criteria.

The selected remedies will effectively reduce site risks by removing or treating significant amounts of contaminants and safely containing the remaining material. The cover and groundwater controls will prevent contact with hazardous materials remaining on site (following removal and treatment) at levels that might pose an unacceptable risk. The cover and shoreline protection will be designed to address potential erosion and earthquakes, in accordance with the substantive provisions of pertinent ARARs. In addition, the selected remedies will be subject to statutory reviews every 5 years, pursuant to CERCLA, to ensure that they remain protective of human health and the environment. The selected remedies allow the property to be used in the future in a manner consistent with CCSF's 2010 redevelopment plan and include monitoring and maintenance that would be performed as long as necessary to protect human health and the environment.

2.9.2. Description of Selected Remedy

The selected remedies for Parcel E will address soil, shoreline sediment, groundwater, NAPL, and residual radiological contamination. The four selected remedies are described below and will be **further developed in the RD**(55).

2.9.2.1. Removal, Treatment, and Containment of Soil and Shoreline Sediment (Alternative S-4)

Alternative S-4 includes excavation of Tier 1 and Tier 2 locations where remediation goals are exceeded (by more than five times) with offsite disposal at a permitted disposal facility. Alternative S-4 also includes excavation of TPH locations (that are commingled with CERCLA-regulated substances) where the remediation goal is exceeded, with offsite disposal at a permitted disposal facility. This alternative also provides for covers, ICs, and shoreline protection. In total, 109 areas in Parcels E are planned for excavation (Figure 11), with a total of approximately 42,000 cubic yards (about 3,250 truckloads) of soil estimated to be removed and disposed of at an approved offsite landfill. As described in Section 2.5.3, the Navy is conducting a soil investigation adjacent to the shoreline in the northwest portion of Parcel E (Figure 11) that may identify additional Tier 1, Tier 2, and TPH locations requiring excavation and offsite disposal. The planned excavation areas generally range from 2 to 10 feet deep, but include isolated TPH locations adjacent to the Former Oily Waste Ponds that are up to 16 feet deep. The RD will further evaluate soil concentrations at

Tier 1, Tier 2, and TPH locations (using additional data collected during investigations performed in 2012 and 2013) and may refine the extent of the proposed excavations (based on the soil action levels that correspond to five times the remediation goals). The RD will also specify the collection of soil confirmation samples to ensure that the Tier 1, Tier 2, and TPH locations are adequately removed, so remaining chemical concentrations at these locations do not exceed the soil action levels (corresponding to five times the remediation goals; see Table 4) or the petroleum source criterion (3,500 mg/kg of total TPH). The areas of Parcel E with buried steam and fuel lines will be cleaned and closed.

At Building 406 in Parcel E, where volatile chemicals are present in soil and soil gas, an SVE system will be installed and operated to extract contaminated soil gas (using a vacuum technology) and treat the removed vapors (using adsorbent material like a charcoal filter). SVE would be performed at Building 406 until soil gas action levels are achieved or until systematic asymptotic conditions are reached without reasonable indication of further reduction based on system monitoring results. Following active treatment, soil gas monitoring will be performed at Building 406, and VOC groundwater plumes requiring treatment (as described in Section 2.9.2.2), to evaluate chemical concentrations in soil gas relative to risk-based action levels (as described in Section 2.7). As noted in Section 2.3.2, a recent study (performed from 2009 to 2012) identified elevated concentrations of VOCs in soil and soil gas at IR-04 (near Building 810). The elevated VOC concentrations in soil and soil gas appear to be limited to a small area that is directly adjacent to a Tier 1 location where excavation and offsite disposal is required for metals and PCBs (see Figure 11). The RD will further evaluate VOCs in soil and soil gas in this area and may propose expanding the excavation at this Tier 1 location to address VOCs in vadose zone soil (up to 10 feet bgs), if deemed necessary to satisfy the soil gas RAO. Additionally, a soil gas survey will be conducted, following a planning process performed in consultation with the regulatory agencies, in Parcel E to:

- investigate soil gas in areas planned for mixed use where concerns continue about residual VOCs in soil (at concentrations that may pose an unacceptable risk via vapor intrusion);
- identify COCs for which risk-based numeric action levels for VOCs in soil gas would be established (based on a cumulative excess cancer risk of 1 in a million); and
- evaluate and map the extent to which areas with potential unacceptable risk via vapor intrusion require control (as described in Section 2.9.2.5, areas with unacceptable vapor intrusion risk will be subject to institutional controls, and the potential risk will be reduced by engineering controls or other design alternatives that meet the specifications set forth in the ROD, RD reports, and LUC RD report).

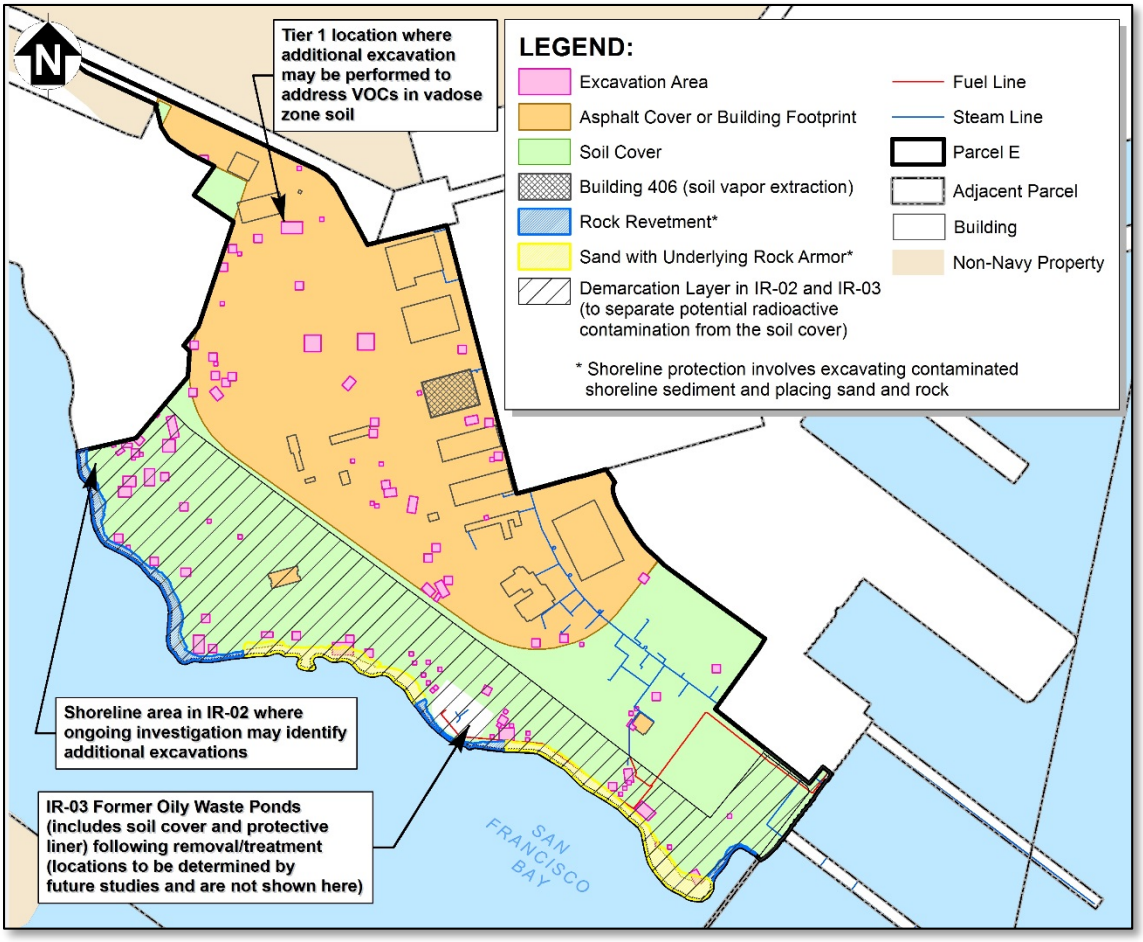

Figure 11. Soil Remediation Areas

As described above, the selected remedy includes cleanup for TPH that are commingled with CERCLA-regulated substances. For areas where TPH in soil are not commingled with CERCLA-regulated substances or TPH remains after CERCLA cleanup is complete, the TPH cleanup would be conducted under the Navy's TPH Corrective Action Program for Parcel E and would not be addressed by the Navy's CERCLA program.

Durable covers would be applied across all of Parcel E as physical barriers to cut off potential exposure to residual contamination that remains in soil after excavation. Durable covers at Parcel E would consist of asphalt and concrete surfaces in the northern half of Parcel E (the Shipyard South Multi-Use District) and a 2-foot thick soil cover in the southern half and in small areas on the western edge of Parcel E (the Shipyard Shoreline Open Space District). The durable covers, which will be designed in the RD, will satisfy performance standards consistent with the pertinent state and federal ARARs (see Attachment 4), including those related to surface water drainage, erosion control, and slope stability. In addition, the cover design will also require the evaluation of subsurface methane, which was previously reported in isolated areas within IR-03 and IR-12, to determine if control measures (such as passive vents) are required to protect human health in accordance with Title 27 California Code of Regulations § 20921(a).

Two areas in Parcel E—IR-03 (the Former Oily Waste Ponds) and the northwest portion of IR-02—require additional actions to properly contain contaminants that remain in soil after excavation. A protective liner (consisting of high-density polyethylene) would be installed under the soil cover in these two areas to minimize water seeping into contaminated soil. The protective liners would work with the below-ground barriers (under Alternatives GW-3 and O-4) to minimize migration of contaminants to San Francisco Bay, as described in Section 2.9.2.2.

In addition, contaminated sediment along the Parcel E shoreline would be excavated to a depth of at least 2.5 feet (which aligns with the **exposure depth for aquatic wildlife**(56) that may inhabit the shoreline) and disposed of at an approved offsite landfill. The shoreline excavations would be backfilled with natural materials (such as sand) and large rocks to prevent exposure to remaining contaminants in shoreline sediment (and to integrate with the durable covers at onshore areas). The shoreline adjacent to IR-03 and the northwest portion of IR-02 is steep and requires stronger protection. A rock revetment structure (about 2,400 feet long), consisting of large rocks placed on the shoreline slope, is proposed to prevent exposure to contaminated soil and shoreline sediment by controlling erosion and protecting the edge of the covered upland area. The remaining shoreline in Parcel E (about 2,400 feet long) has more gradual slopes and would be protected with natural materials (such as sand) over a protective rock layer to prevent exposure to contaminated soil and shoreline sediment. The covers and the shoreline protection features would be inspected and maintained regularly to ensure they remain intact. The Navy would also implement ICs after these activities for continued protection of public health and the environment and to ensure the integrity of the containment remedies (for example, soil covers).

2.9.2.2. Treatment and Containment of Groundwater (Alternative GW-3)

Alternative GW-3 would achieve RAOs by actively treating VOC groundwater plumes at Parcel E using injected biological nutrients to accelerate the breakdown of VOCs to less toxic compounds. Figure 12 on page 2-50 identifies the groundwater plumes to be treated. The Building 406 plume may require more aggressive treatment using injected zero-valent iron (potentially mixed with biological nutrients), if determined necessary in the RD to satisfy the soil gas RAO (as described in Section 2.7). The injection process will be developed in the RD and will be implemented in a manner that allows for regular optimization so that the RAOs are met in a timely, cost-effective manner while minimizing negative environmental effects (e.g., energy consumption, greenhouse gas emissions, and accident risk). The optimization process will be informed by performance monitoring data for various factors that are critical to successful in-situ treatment (e.g., changes in VOC concentrations within the groundwater plume, and geochemical conditions that are conducive to natural degradation of VOCs). Potential optimization measures may include modifying the amount or type of treatment material, or modifying the injection method to improve the distribution of the treatment chemicals. Active treatment will be performed until the technology is no longer the most cost-effective or environmentally sustainable option, at which point a recommendation will be made to transition to MNA. The recommended transition to MNA, which would be subject to approval by the FFA signatories, will need to demonstrate that natural processes are adequately degrading the remaining VOCs (to allow RAOs to be achieved in a timely manner), and that continued active treatment would be less cost-effective and environmentally sustainable (in comparison to MNA).

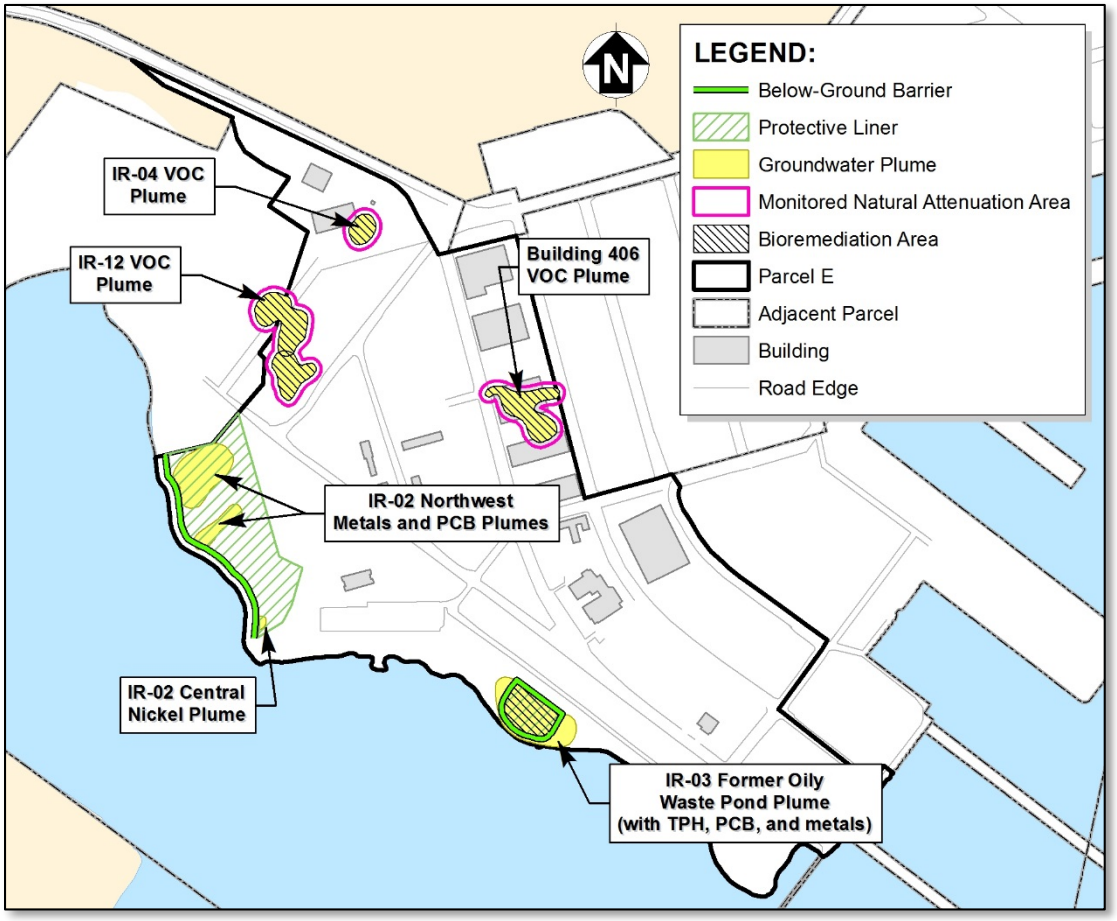

Figure 12. Groundwater Remediation Areas

As part of the performance monitoring, groundwater quality (as well as flow direction) will be monitored at the VOC groundwater plumes to evaluate the breakdown of VOCs to less toxic compounds, and soil gas will be monitored to evaluate concentrations relative to risk-based action levels (as described in Section 2.7). Groundwater monitoring will continue until chemical concentrations meet remediation goals, and soil gas monitoring will continue until chemical concentrations are less than risk-based action levels. ICs will be implemented to restrict access to and use of contaminated groundwater (both VOC groundwater plumes and other groundwater plumes near San Francisco Bay).

For groundwater plumes near San Francisco Bay containing metals and PCBs (at IR-02), a below-ground barrier will be constructed to control discharge of contaminated groundwater into the bay. The below-ground barrier would work with the protective liners (under Alternative S-4) to minimize migration of contaminants to San Francisco Bay. The below-ground barrier would decrease the groundwater flow gradient and consequently increase the residence time (for groundwater behind the barrier) during which chemical concentrations would be reduced through physical, chemical, and biological processes. The presence of the barrier would lead to hydraulic head buildup behind it, which would dissipate by lateral movement of groundwater around the barrier. In addition, the hydraulic head buildup behind the barrier

would be lower during high tides, when bay waters move inland through the tidal mixing zone. Groundwater quality (as well as flow direction) will be monitored at the plumes behind the below-ground barrier to ensure that contamination is not discharged into San Francisco Bay at concentrations greater than the corresponding **surface water quality criteria for aquatic wildlife**(39) (to comply with the groundwater RAO specified in Section 2.7). Plume-specific **trigger levels**(30)[13] will be used as groundwater monitoring criteria to evaluate the potential risk to aquatic wildlife in San Francisco Bay, but the RD may develop alternative monitoring criteria (using refined fate and transport modeling) to more rigorously assess the groundwater-to-surface water transport mechanism.

2.9.2.3. Removal, Treatment, and Containment of NAPL at IR-03 (Alternative O-4)

Alternative O-4 would achieve RAOs by using a combination of technologies (such as excavation and offsite disposal, in-situ stabilization/solidification, or thermally-enhanced extraction) to remove or treat the NAPL contaminant source. The Navy will perform additional studies to select the best combination of technologies to cost-effectively remove or treat the NAPL contaminant source at IR-03; as described in Section 2.3.3, the Navy is conducting a study at IR-03, concurrent with this ROD, to further characterize the the NAPL and test two technologies (in-situ stabilization/solidification and thermally-enhanced extraction) in the field. The FS Report assumed for cost-estimating purposes that the NAPL source removal and treatment activities would be limited to the area within the IR-03 site boundary (corresponding to the IR-03 area on Figure 12 encircled by the green line), where the distribution of NAPL is the most extensive. NAPL associated with the Former Oily Waste Ponds is present outside the IR-03 boundary, and the cost estimates for Alternative S-4 assume these areas will be addressed by excavation and offsite disposal. The RD will evaluate the data from recent studies and determine the extent to which removal and treatment technologies can cost-effectively satisfy the NAPL RAOs (as described in Section 2.7). Based on this determination to be provided in the RD, the NAPL removal and treatment area may be increased or decreased, with the remaining NAPL contamination being addressed by containment, monitoring, and ICs.

As described for Alternative S-4, a 2-foot-thick soil cover with protective liner would be constructed to prevent exposure to remaining contaminants and limit groundwater infiltration. Also, as described for Alternative GW-3, a below-ground barrier would be constructed to control discharge of NAPL and contaminated groundwater into San Francisco Bay. Following removal or treatment of the NAPL, biological nutrients would be injected to create conditions where remaining contaminants in groundwater are broken down to less toxic compounds. As described for Alternative GW-3, the injection process will be developed in the RD, and will be implemented in a manner that allows for regular optimization so that the RAOs are met in a timely, cost effective manner while minimizing negative environmental effects (e.g., energy consumption, greenhouse gas emissions, and accident risk). The optimization process will be informed by performance monitoring data for various factors that are critical to successful in-situ treatment

[13] Trigger levels were developed (in the FS Report for Parcel E) for specific groundwater plumes by applying attenuation factors to pertinent surface water quality criteria (as identified in pertinent surface water ARARs and, for select metals, adjusted for ambient levels). The attenuation factors vary based on several parameters (most notably, width of the contaminant plume and distance to the bay) and provide a conservative estimate of the advection and dispersion that reduces chemical concentrations as groundwater moves from an inland location to San Francisco Bay. Further information on the development of trigger levels is provided in the hyperlinked reference document (Attachment 2).

(e.g., changes in contaminant concentrations within the groundwater plume, and geochemical conditions that are conducive to natural degradation of the remaining contaminants). Potential optimization measures may include modifying the amount or type of treatment material, or modifying the injection method to improve the distribution of the treatment chemicals. Active treatment will be performed until the technology is no longer the most cost-effective or environmentally sustainable option, at which point a recommendation will be made to transition to MNA. The recommended transition to MNA, which would be subject to approval by the FFA signatories, will need to demonstrate that natural processes are adequately degrading the remaining contaminants (to allow RAOs to be achieved in a timely manner), and that continued active treatment would be less cost effective and environmentally sustainable (in comparison to MNA).

Similar to Alternative GW-3, groundwater quality (as well as flow direction) will be monitored to ensure that contamination is not discharged into San Francisco Bay at concentrations greater than the corresponding **surface water quality criteria for aquatic wildlife**(39) (these criteria also include, consistent with the NAPL RAO in Section 2.7, a discharge limit for total TPH of 1,400 µg/L). Plume-specific **trigger levels**(30)[14] will be used as groundwater monitoring criteria to evaluate the potential risk to aquatic wildlife in San Francisco Bay, but the RD may develop alternative monitoring criteria (using refined fate and transport modeling) to more rigorously assess the groundwater-to-surface water transport mechanism. In addition, ICs would be implemented to restrict access to and use of contaminated groundwater.

2.9.2.4. Removal and Containment of Radiologically Impacted Media (Alternative R-2)

Alternative R-2 would achieve RAOs by performing the following actions: (1) scanning radiologically impacted areas at Parcel E that may include structures (requiring aboveground scans), former building sites (requiring surface scans), and buried storm drain and sewer lines (requiring subsurface scans); (2) decontaminating (and demolishing if necessary) buildings at Parcel E (demolition of small buildings may be performed if deemed the most cost-effective means of achieving the RAOs); (3) screening, separating, and disposing of radiologically contaminated debris and soil at an approved landfill; and (4) performing final surveys to demonstrate remediation goals have been met. The final radiological cleanup has been initiated (under a time-critical removal action) in all of Parcel E areas except IR-02 and IR-03 (see Figure 7). The Navy has also removed storm drain and sewer lines throughout most of Parcel E as part of the same radiological removal action. As described in Section 2.3, the radiological removal action is scheduled for completion in 2015 and the results will be summarized in a final RACR, which will be reviewed and approved by the FFA signatories and CDPH. Although the radiological removal action will not be completed by the time this ROD is signed, the removal action is intended to achieve cleanup goals identical to the RAOs specified in this ROD. If the removal action does not achieve its cleanup goals, cleanup will continue in accordance with the remedial action selected in this ROD until the RAOs are achieved.

[14] Trigger levels were developed (in the FS Report for Parcel E) for specific groundwater plumes by applying attenuation factors to pertinent surface water quality criteria (as identified in pertinent surface water ARARs and, for select metals, adjusted for ambient levels). The attenuation factors vary based on several parameters (most notably, width of the contaminant plume and distance to the bay) and provide a conservative estimate of the advection and dispersion that reduces chemical concentrations as groundwater moves from an inland location to San Francisco Bay. Further information on the development of trigger levels is provided in the hyperlinked reference document (Attachment 2).

The ongoing removal action does not address IR-02 and IR-03 because nonradioactive chemicals in soil and shoreline sediment within these areas require remedial action, which would be performed concurrent with future radiological remediation. Alternative R-2 would achieve RAOs and address the radiologically impacted media in IR-02 and IR-03 by performing the following actions: (1) scanning the entire area for radioactivity to a depth of at least 1 foot; (2) removing residual radiological contamination to a depth of 1 foot (the maximum effective depth of the surface survey) and disposing of it at an approved landfill; (3) constructing a 2-foot-thick soil cover (as provided by the selected remedy for soil, Alternative S-4) to prevent exposure to remaining contaminants and installing a demarcation layer to mark the boundary between the existing surface and the soil cover (see Figure 11); (4) conducting regular inspections and maintenance (as provided by the selected remedy for soil, Alternative S-4) of the soil cover and adjoining shoreline protection features to ensure their integrity; and (5) implementing ICs to limit the use of land or restrict activities that take place within the area. Deeper soil excavation would be performed at IR-02 and IR-03, if necessary, to ensure that the residual radiological risk (i.e., the incremental excess cancer risks from exposure to radionuclides in soil) at the final ground surface (following installation of a demarcation layer and soil cover) is acceptable. The residual radiological risk at the final ground surface (based on residential exposure) would be within the risk management range specified in the NCP (10^{-6} to 10^{-4}). In preparing the RD, the Navy would work closely with the regulatory agencies to develop specific protocols for determining when deeper soil excavation is needed to ensure that the residual radiological risk at the final ground surface is acceptable. In addition, the Navy would perform radiological risk modeling, in conjunction with the final radiological surveys, to verify that the residual radiological risk is acceptable. Buried storm drain and sewer lines in IR-02 and IR-03 would remain in place because the soil cover and ICs would prevent exposure to residual radiological contamination in these lines. Also, future groundwater monitoring would be performed in IR-02 and IR-03 to demonstrate, consistent with the findings of previous radiological investigations, that radionuclides are not present in groundwater at activity levels that are both statistically significant and pose an unacceptable risk to human health and the environment. The determination of statistical significance will be made in accordance with the substantive provisions of Title 22 California Code of Regulations § 66264.98(i). The duration of the groundwater monitoring for radionuclides will be determined in accordance with Title 22 California Code of Regulations § 66264.90(c).

2.9.2.5. Monitoring, Maintenance, and Institutional Controls

Each of the selected remedies includes the monitoring and maintenance activities that would be performed as long as necessary to protect human health and the environment and to comply with the substantive provisions of pertinent state and federal ARARs (see Attachment 4). In addition, the selected remedy will be subject to statutory reviews every 5 years pursuant to CERCLA to ensure that it remains protective of human health and the environment.

The Navy would also implement ICs, which are legal and administrative mechanisms for the continued protection of human health and the environment. In Parcel E, the objectives of the ICs are to implement land use and activity restrictions that are used to limit the exposure of future landowner(s) or user(s) of the property to hazardous substances present on the property and in groundwater, and to ensure the integrity of the remedial action, including any current or future remedial or monitoring systems such as monitoring wells and

subsurface groundwater control barriers. Institutional controls are required on a property where the selected remedial action results in contamination remaining at the property above levels that allow for unlimited use and unrestricted exposure. The ICs for Parcel E would restrict the development, land use, and activities on Parcel E property as described in this ROD. These ICs would be maintained until the concentrations of hazardous substances in soil and groundwater are at such levels to allow for unrestricted use and exposure. Implementation of ICs at Parcel E includes requirements for monitoring and inspections and reporting to ensure compliance with land use or activity restrictions. Figure 13 presents the area requiring institutional controls (ARIC) for nonradioactive chemicals, which comprises all of Parcel E. Figure 12 also identifies the ARIC for radionuclides (pink shading on Figure 13; also referred to as the radiological ARIC), which consists of all of IR-02 and IR-03. Outside of the radiological ARIC, potential radioactive contamination exceeding the remediation goals would be removed, thus these areas would not require ICs regarding exposure to radioactivity.

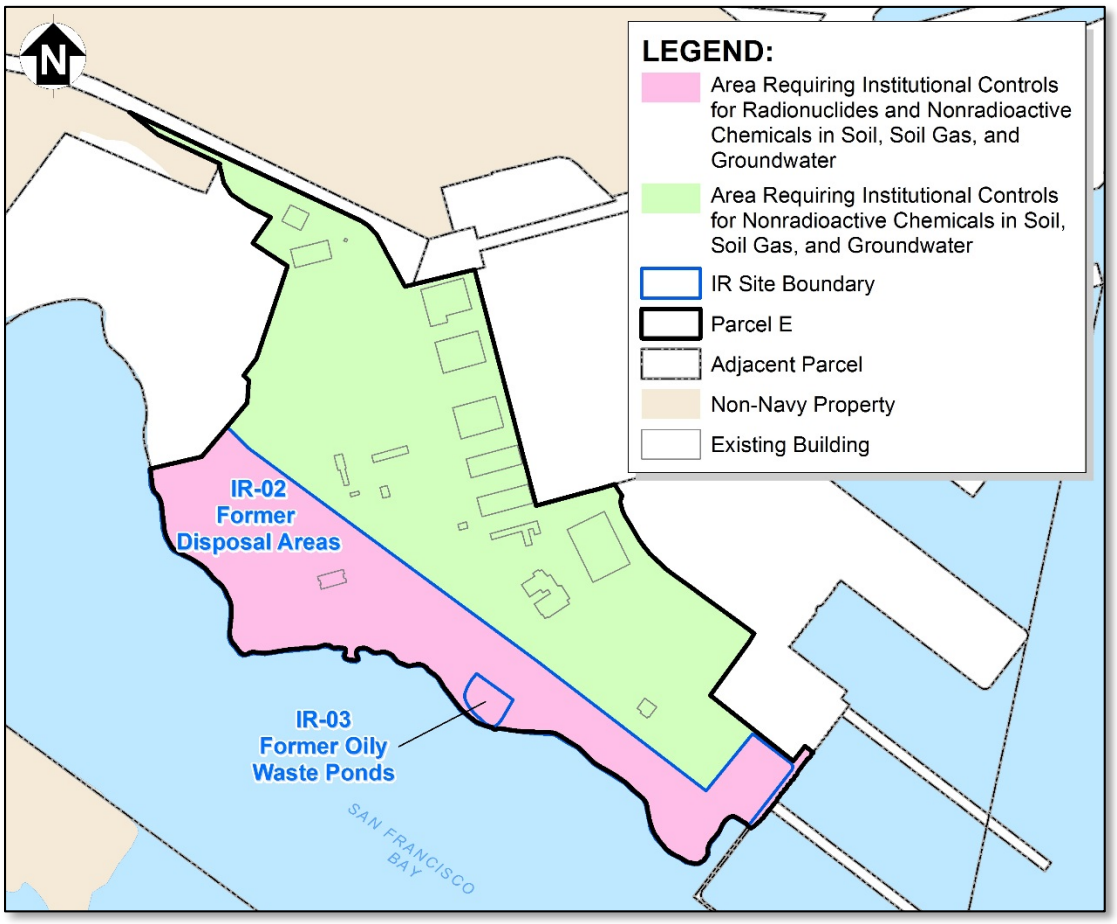

Figure 13. Area Requiring Institutional Controls

The Navy has determined that it will rely on proprietary controls in the form of environmental restrictive covenants as provided in the "Memorandum of Agreement between the United States Department of the Navy and the California Department of Toxic Substances Control" (hereinafter referred to as the "Navy/DTSC MOA").

More specifically, land use and activity restrictions will be incorporated into two separate legal instruments as provided in the Navy/DTSC MOA:

1. Restrictive covenants included in one or more Quitclaim Deeds from the Navy to the property recipient.
2. Restrictive covenants included in one or more "Covenant to Restrict Use of Property" entered into by the Navy and DTSC as provided in the Navy/DTSC MOA and consistent with the substantive provisions of Title 22 California Code of Regulations § 67391.1.

The "Covenant(s) to Restrict Use of Property" will incorporate the land use and activity restrictions into environmental restrictive covenants that run with the land and that are enforceable by DTSC against future transferees. The Quitclaim Deed(s) will include the identical land use and activity restrictions in environmental restrictive covenants that run with the land and that will be enforceable by the Navy against future transferees.

The land use and activity restrictions in the "Covenant(s) to Restrict Use of Property" and Quitclaim Deed(s) shall be further defined in the land use control remedial design (LUC RD) report that would be prepared by the Navy and reviewed and approved by the other FFA signatories. The LUC RD report shall be referenced in the applicable Covenant to Restrict Use of Property and Deed. CCSF may prepare a risk management plan (RMP) to be approved by the FFA signatories that may set forth certain requirements and protocols used to conduct restricted activities that shall be overseen by the FFA signatories (and CDPH for restricted activities conducted within the radiological ARIC).

In addition to being set forth in the "Covenant(s) to Restrict Use of Property" and Quitclaim Deed(s) as described above, restrictions applied to specified portions of the property will be described in findings of suitability to transfer.

Access

The Deed and Covenant shall provide that the Navy and other FFA signatories, where applicable, and for CDPH in the radiological ARIC, and their authorized agents, employees, contractors, and subcontractors shall have the right to enter upon HPNS Parcel E to conduct investigations, tests, or surveys; inspect field activities; or construct, operate, and maintain any response or remedial action as required or necessary under the cleanup program, including but not limited to monitoring wells, pumping wells, treatment facilities, and cap and containment systems.

Implementation

The Navy shall address and describe implementation and maintenance actions for ICs, including periodic inspections and reporting requirements, in the preliminary and final RD reports to be developed and submitted to the other FFA signatories for review pursuant to the FFA (see "Navy Principles and Procedures for Specifying, Monitoring and Enforcement of Land Use Controls and Other Post-ROD Actions" attached to January 16, 2004 Department of Defense memorandum titled "Comprehensive Environmental Response,

Compensation and Liability Act [CERCLA] Record of Decision [ROD] and Post-ROD Policy"). The preliminary and final RD reports are primary documents as provided in Section 7.3 of the FFA.

The Navy is responsible for implementing, maintaining, reporting on, and enforcing ICs. Although the Navy may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for integrity of the remedy.

Land Use and Activity Restrictions

The following paragraphs describe the IC objectives to be achieved through land use and activity restrictions to ensure that any necessary measures to protect human health and the environment and the integrity of the remedy have been undertaken.

General Activity Restrictions

The following restricted activities throughout HPNS Parcel E must be conducted in accordance with the "Covenant(s) to Restrict Use of Property," Quitclaim Deed(s), the Operation and Maintenance Plan(s), LUC RD report and, if deemed necessary, the RMP and any other work plan or document approved in accordance with these referenced documents:

a. "Land disturbing activity," which includes but is not limited to (1) excavation of soil and sediment; (2) construction of roads, utilities, facilities, structures, and appurtenances of any kind; (3) demolition or removal of "hardscape" (for example, concrete roadways, parking lots, foundations, and sidewalks); (4) any activity that involves movement of soil to the surface from below the surface of the land; and (5) any other activity that causes or facilitates the movement of groundwater known to be contaminated with radionuclides or nonradioactive chemicals. Land-disturbing activities are not intended to include placement of additional clean, imported fill on top of the soil cover that the Navy will construct at HPNS Parcel E.

b. Alteration, disturbance, or removal of any component of a response or cleanup action (including but not limited to pump-and-treat facilities, revetment walls and shoreline protection, and soil cap/containment systems); groundwater extraction, injection, and monitoring wells and associated piping and equipment; or associated utilities.

c. Extraction of groundwater and installation of new groundwater wells.

d. Removal of or damage to security features (e.g., locks on monitoring wells, survey monuments, fencing, signs, or monitoring equipment and associated pipelines and appurtenances).

In addition, the following activities are prohibited throughout HPNS Parcel E:

a. Growing vegetables, fruits, and any edible items in native soil for human consumption. Plants for human consumption may be grown if they are planted in raised beds (above the CERCLA-approved cover) containing non-native soil. Trees producing edible fruit (including trees producing edible nuts) may also be planted provided they are grown in containers with a bottom that prevents the roots from penetrating the native soil.

b. Use of groundwater.

Activity Restrictions Relating to Soil and Associated VOC Vapors at Specific Locations within Parcel E

Any proposed construction and occupancy of enclosed structures within the ARIC for VOC vapors must be approved by the FFA signatories in accordance with the "Covenant to Restrict Use of the Property," Quitclaim Deed, and LUC RD to ensure that the risks of potential exposures to VOC vapors are reduced to acceptable levels that are adequately protective of human health. The ARIC for VOC vapors currently includes the entire ARIC for nonradioactive chemicals (both the green and pink shaded areas) shown on Figure 13.

The reduction in potential risk can be achieved through engineering controls or other design alternatives that meet the specifications set forth in the ROD, RD reports, and LUC RD report. When construction of enclosed structures or reuse of an existing building is proposed in an ARIC for VOC vapors, the FFA signatories must approve the design of the vapor control system built into foundations. In addition, enclosed structures within the ARIC for VOC vapors at Parcel E shall not be occupied until the Owner has requested and obtained FFA signatory approval (through approval of a RACR or similar document) that any necessary engineering controls or design alternatives have been properly constructed and are operating successfully.

The FFA signatories may modify the ARIC as soil contamination areas and groundwater contaminant plumes that are producing unacceptable vapor inhalation risks are reduced over time or in response to further soil, vapor, and groundwater sampling and analysis for VOCs that establishes that areas now included in the ARIC do not pose unacceptable potential exposure risk to VOC vapors.

Additional Land Use Restrictions for IR-02 and IR-03 and Other Areas Designated for Open Space Reuse

In addition to the specific activities prohibited below, IR-02 and IR-03 would be restricted to open space and recreational uses, unless written approval for other uses is granted by the FFA signatories and CDPH. In addition, the following land uses would be specifically prohibited unless written approval for such uses is granted by the FFA signatories and the CDPH in accordance with the "Covenant(s) to Restrict Use of the Property," Quitclaim Deed(s), and LUC RD report:

a. A residence, including any mobile home or factory built housing, constructed or installed for use as residential human habitation.

b. A hospital for humans.

c. A school for persons under 21 years of age.

d. A daycare facility for children.

The restricted land uses identified above shall also apply to property areas in the Shipyard Shoreline Open Space District, as identified in the CCSF's 2010 redevelopment plan for HPNS, unless written approval for such uses is granted by the FFA signatories in accordance with the "Covenant(s) to Restrict Use of the Property," Quitclaim Deed(s), and LUC RD report. Parcel E property areas within the Shipyard Shoreline Open Space District are identified as Redevelopment Blocks EOS-1, EOS-2, EOS-3, EOS-4, EOS-5A, EOS-5B, and EOS-5C (Figure 5).

Additional Activity Restrictions Related to Radionuclides at Parcel E

Exposure to radionuclides in the radiological ARIC, comprising IR-02 and IR-03 (see Figure 13), would be prevented by three separate components: (1) an engineered cover, consisting of clean imported fill and (in some areas) a low hydraulic conductivity layer, to provide adequate shielding against residual radioactivity; (2) permeable geosynthetic fabric to serve as a demarcation layer between soil cover and underlying soil with residual radioactivity; and (3) ICs to implement land use and activity restrictions necessary to limit the exposure to radiological hazardous substances and to ensure the integrity of the remedial action.

In addition to the land use and activity restrictions specified above, the following activity restriction would apply in the radiological ARIC.

a. Land-disturbing activities within the radiological ARIC, as defined above and including installation of water lines, storm drains, or sanitary sewers below the demarcation layer, are strictly prohibited unless approved in writing by the FFA signatories and the CDPH. Any proposed land-disturbing activity within the ARIC for radionuclides shall be described in a work plan that will include but not be limited to a radiological work plan, the identification of a radiological safety specialist, a soil management plan, soil sampling and analysis requirements, and a plan for offsite disposal of any excavated radionuclides by the transferee in accordance with federal and state law. This work plan must also specify appropriate procedures for the proper identification and handling of material potentially presenting an explosive hazard[15]. This work plan must be submitted to and approved in writing by the FFA signatories and CDPH in accordance with procedures (including dispute resolution procedures) and timeframes that will be set forth in the Parcel E Operations and Maintenance Plan (OMP) and LUC RD Report.

b. Following implementation of an approved land-disturbing activity within the radiological ARIC, the integrity of the cover/cap must be restored upon completion of excavation as provided in the OMP, LUC RD report, or similar document. A completion report describing the details of the implementation of the work plan, sampling and analysis (if required), offsite disposal (if required), and the restoration of the integrity of the cover/cap must be submitted to and approved in writing by the FFA signatories and CDPH in accordance with procedures (including dispute resolution procedures) and timeframes that will be set forth in the OMP and LUC RD Report.

c. For land-disturbing activities, as defined above and including installation of water lines, storm drains, or sanitary sewers above the demarcation layer, the LUC RD report, the OMP, or, if deemed necessary, the RMP or a project-specific work plan will list the procedures for ensuring that the cover is not disturbed or breached. The specific design of the cover shall be agreed to in the RD. Installation of water lines, storm drains, or sanitary sewers in any additional clean, imported fill placed on top of the soil cover that the Navy has constructed at the Property is not intended to be restricted if the property owner demarcates the interface between the preexisting cover and any new imported soil.

[15] Previous radiological removal actions in IR-02 encountered material potentially presenting an explosive hazard that required inspection by qualified unexploded ordnance technicians and handling/disposal in accordance with Department of Defense guidelines. This prior finding necessitates similar protocols for future land-disturbing activities within the radiological ARIC (which includes all of IR-02 and IR-03).

At the time of transfer, the areas that require this restriction will be surveyed to define the legal metes and bounds for inclusion in the property transfer documents. No variance or exemption from this restriction shall be allowed unless written approval is provided by the FFA signatories and CDPH. The OMP or LUC RD report shall address any necessary additional soil and radiological management requirements; for example, inspections, monitoring, and reporting requirements for portions of Parcel E in the radiological ARIC.

2.9.3. Expected Outcomes of the Selected Remedy

Once the selected remedies have been implemented, risks to human health and the environment under the planned future uses will be acceptable and the RAOs will be achieved. Removal and offsite disposal of soil, shoreline sediment, NAPL, and radiologically impacted media in selected areas will reduce site risks, and the cover will prevent contact with remaining contamination that might pose an unacceptable risk. Treatment of soil gas, groundwater, and NAPL in selected areas will reduce concentrations of nonradioactive chemicals and reduce their migration potential. The groundwater remedy is expected to achieve the remediation goals presented in Table 7 via active treatment and MNA of VOCs in groundwater to restore the aquifer quality by reducing or immobilizing the mass of COCs in groundwater to levels that do not pose a threat to human health through the inhalation exposure pathway. As described in Section 2.9.2.2, active treatment will be performed until the technology is no longer the most cost-effective or environmentally sustainable option, at which point MNA will be relied upon to degrade the remaining VOCs (following approval by the FFA signatories). Although active treatment of groundwater (with MNA) is expected to reduce VOC and SVOC vapors released from groundwater, ICs for vapor intrusion may be needed at some locations at Parcel E (as discussed in Section 2.9.2.5). Furthermore, the Navy intends to permanently prohibit use of groundwater at Parcel E through implementation of ICs.

The remedy for radiologically impacted media includes surveys, decontamination, excavation, and offsite disposal. Removal of contaminants from radiologically impacted buildings and former building sites with documented radiological impacts and removal of potential radiologically impacted sanitary and storm sewers and soil are expected to result in a reduction of the potential risks to levels less than the remediation goals presented in Table 8 associated with exposure to ROCs.

The selected remedies will take a relatively short period of time to implement and will use readily available technologies and labor. Following implementation, long-term monitoring, MNA, and maintenance will ensure the continued protection of human health and the environment. In addition, ICs will restrict potential exposure to contaminated soil, shoreline sediment, and groundwater and the restrictions will be consistent with the planned future use of Parcel E.

2.9.4. Statutory Determinations

In accordance with the NCP, the selected remedies meet the following statutory determinations.

- **Protection of Human Health and the Environment** – The selected remedies will adequately protect human health and the environment by preventing exposure to COCs and COECs through (1) removal and offsite disposal of soil, shoreline sediment, NAPL, and radiologically impacted media to significantly reduce risks in selected areas; (2) treatment of soil gas, groundwater, and NAPL to reduce the potential for contaminant migration in selected areas; and (3) installation and monitoring of soil and groundwater containment systems (including durable covers and below-ground barriers) and the implementation of ICs.
- **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)** – CERCLA § 121(d)(1) states that remedial actions on CERCLA sites must attain (or the decision document must justify the waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. The selected remedies for Parcel E will comply with the substantive provisions of the federal and state requirements identified as ARARs. The chemical-, location-, and action-specific ARARs for the selected remedy are summarized in Attachment 4.
- **Cost-Effectiveness** – As specified in the NCP, the cost-effectiveness of a remedy is determined in two steps. First, the overall effectiveness of a remedial alternative is determined by evaluating the following three of the five balancing criteria: (1) long-term effectiveness and permanence; (2) reduction in toxicity, mobility, or volume through treatment; and (3) short-term effectiveness. The overall effectiveness is then compared to cost to determine whether a remedy is cost-effective. The selected remedies have a high overall effectiveness because, relative to the other remedial alternatives, they offer a high degree of long-term effectiveness in a manner that maximizes the use of treatment (to reduce the toxicity, mobility, or volume of contaminants) and minimizes short-term risks. The selected remedies will provide high overall effectiveness proportional to their costs. For example, Alternatives S-4 and GW-3 offer improved overall effectiveness for a modest incremental cost increase (relative to other alternatives). Therefore, the selected remedies are considered cost-effective. In contrast, Alternative O-6 is not considered cost-effective because its lower overall effectiveness (relative to Alternative O-4) is accompanied by a significant incremental cost increase (nearly 50 percent relative to Alternative O-4).
- **Use of Permanent Solution and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable** – The Navy has determined that the selected remedies represent the maximum extent to which permanent solutions and treatment are practicable at this site. The selected remedies include treatment components to reduce toxicity, mobility, or volume of VOCs in soil gas and groundwater at various locations, as well as NAPL at IR-03. For the soil remedy, the Navy concluded that, because soil contamination is widely dispersed across the parcel, a containment remedy combined with excavation of more highly contaminated soil represents the maximum extent to which permanent solutions can be used in a cost-effective manner. For the NAPL at IR-03, the Navy concluded that the selected remedy (Alternative O-4) provides the best balance of tradeoffs relative to the five balancing criteria: (1) long-term effectiveness and permanence; (2) reduction in toxicity, mobility, or volume through treatment; (3) short-term effectiveness; (4) implementability; (5) and cost. Alternative O-4 provides a high degree of long-term effectiveness, although not as high as Alternative O-6, because the NAPL contaminant source would be removed and treated, and the final soil cover, protective liner, and below-ground barrier (for groundwater) would protect people and wildlife from being exposed to remaining contamination. Alternative O-4 provides the highest degree of short-term effectiveness and implementability because it uses proven and accepted technologies

that can be implemented more quickly and readily than the other alternatives, most notably Alternative O-6, thereby reducing the short-term risks to site workers and the surrounding community. Alternative O-4 would cost significantly less than Alternative O-6. The selected remedies are expected to be permanent and effective in light of the anticipated land use.

- **Preference for Treatment as a Principal Element** – The selected remedy for soil and shoreline sediment does not satisfy the statutory preference for treatment[16] as a principal element because no cost-effective means of treating the large quantity of low-level soil contamination is available and the quantities of soil to be excavated cannot be treated in a cost-effective manner. With the exception of soil gas treatment (via SVE), the soil and shoreline sediment remedy would not reduce the toxicity, mobility, or volume of contaminants through treatment, but would provide for offsite disposal of more highly contaminated soil at a facility, which would minimize the potential for those hazardous substances to migrate or otherwise pose a threat. The selected remedy for groundwater and NAPL at IR-03 satisfies the statutory preference for treatment as a principal element of the remedy; that is, it would reduce the toxicity, mobility, or volume of contaminants through treatment as a principal element. The selected remedy for radiologically impacted media does not include treatment as a principal element because no technology is available to reduce the toxicity or volume of radionuclides in contaminated soil or building materials.
- **Five-Year Review Requirements** – Statutory five-year reviews pursuant to CERCLA § 121 and the NCP will be conducted because the selected remedies may leave contamination in place at Parcel E above levels that allow for unrestricted use and unlimited exposure. Five-year reviews for Parcel E will follow the ongoing schedule of five-year reviews established for other remedies in place at HPNS (the next five-year review for HPNS will be completed in 2018).

2.9.5. Documentation of Significant Changes

No significant changes were made to the ROD from the information presented in the Proposed Plan.

2.10. COMMUNITY PARTICIPATION

Community participation at HPNS includes public meetings, public information repositories, an IR Program website, newsletters and fact sheets, public notices, and site tours. The Community Involvement Plan for HPNS provides detailed information on community participation for the IR Program and documents interests, issues, and concerns raised by the community regarding ongoing investigation and cleanup activities at HPNS. The Navy held a community meeting on February 2, 2010, to solicit community input on updating the Community Involvement Plan for HPNS. The Navy used this input in preparing an update to the **Community Involvement Plan**(57), which was finalized in May 2011. The Navy is currently working on another update to the community involvement plan, which is scheduled for completion in summer 2013.

Starting in January 2010, the Navy began conducting bimonthly Community Technical Meetings to discuss the technical aspects of the CERCLA milestone documents with community members (and with

[16] As defined in the NCP (Title 40 Code of Federal Regulations § 300.5), "treatment technology" means any unit operation or series of unit operations that alters the composition of a hazardous substance or pollutant or contaminant through chemical, biological, or physical means so as to reduce toxicity, mobility, or volume of the contaminated materials being treated. Treatment technologies are an alternative to land disposal of hazardous wastes without treatment.

participation from the BCT). Documents and relevant information relied upon in the remedy selection process are made available for public review in the public information repositories (listed at the end of this section) or on the **IR Program website**(58).

Community participation is also solicited through public mailings, including newsletters, fact sheets, public notices, and proposed plans, which are designed to broadly disseminate information throughout the local community. Public mailings for HPNS are sent to more than 2,000 groups and individuals that have added their names to the community mailing list, including residents in the local Hunters Point-Bayview community; city, state, and federal officials; regulatory agencies; and other interested groups and individuals. Previous updates and fact sheets have included general program information such as the status of environmental investigations and cleanup activities at each HPNS parcel. In addition, the Navy has held periodic site tours of HPNS to better explain the status of cleanup activities to interested community members.

For Parcel E, a significant effort was made to inform the public of the remedy proposed in the Proposed Plan and selected in this ROD. Prior to making the Proposed Plan available for public review, public notices of the meeting and availability of documents was placed in the *San Francisco Chronicle* on February 10, 2013; the *San Francisco Bayview* on February 1, 2013; and *Sun-Reporter* on February 7, 2013. The Proposed Plan, along with **the associated fact sheet**(59), was distributed to recipients on the community mailing list beginning on February 12, 2013.

In accordance with CERCLA § 113 and § 117, the Navy provided a public comment period from February 13, 2013, to April 1, 2013, for the proposed remedial action described in the Proposed Plan for Parcel E. A public meeting to present the Proposed Plan was held from 6:00 to 9:00 p.m. on February 28, 2013. At the public meeting, the Navy gave presentations on the conditions at Parcel E and representatives from the Navy and regulatory agencies were available to answer questions. A **transcript of the public meeting**(60) prepared by a court reporter is part of the Administrative Record for this ROD and is available on the CD for this ROD. Responses to spoken comments received during the public meeting and written comments received during the public comment period are included in the Responsiveness Summary in Section 3.

Key supporting documents that pertain to Parcel E and a complete index of all Navy HPNS documents are available at the following information repositories:

San Francisco Main Library
100 Larkin Street
Government Information Center, 5th Floor
San Francisco, California 94102
Phone: (415) 557-4500

HPNS Office Trailer
690 Hudson Street
San Francisco, California 94124

For access to the Administrative Record contact:

Naval Facilities Engineering Command Southwest
Attention: Diane Silva, Command Records Manager
2965 Mole Road, Building 3519
San Diego, CA 92136
Phone: (619) 556-1280

For additional information on the IR Program contact:

Mr. Keith Forman
HPNS BRAC Environmental Coordinator
BRAC Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310
Phone: (619) 532-0913
e-mail: keith.s.forman@navy.mil

Section 3. Responsiveness Summary

The responsiveness summary is the third component of a ROD; its purpose is to summarize information about the views of the public and regulatory agencies on both the remedial alternatives and general concerns about Parcel E submitted during the public comment period. It documents in the record how public comments were integrated into the decision-making process. The participants in the public meeting, held on February 28, 2013, included community members and representatives of the Navy, EPA, DTSC, and the Water Board. Questions and concerns received during the meeting were addressed at the meeting and are documented in the meeting transcript. Responses to comments provided at the meeting and received during the public comment period by the Navy, EPA, DTSC, or the Water Board are included in the responsiveness summary (Attachment 3). In addition, responses to comments received on the draft version of this ROD are provided in Attachment 5.

Attachment 3. Responsiveness Summary

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Spoken Comments by Saul Bloom (Arc Ecology) at the public meeting held on February 28, 2013

Comment No.	Comment	Response
1.	I have four comments, the first of which I'll make right now, which is that we are formally requesting that the Navy, regulators, extend the public comment period for the Proposed Plan to March 31.	After consulting with the HPNS[1] regulators, the Navy extended the public comment deadline from March 15, 2013, to April 1, 2013.
2.	In 2009, the Regional Water Control Board entered into an order with —— amendment with the San Francisco Airport in which it established a research program that Arc Ecology is involved in engineering to establish a wetlands on the property in —— on Parcel E midway from the point in between the two zones that the Proposed Plan calls for riprapping or at least doing some additional shore armoring. We look forward to seeing more detail within the final Proposed Plan and the ROD that indicates how the Navy is contemplating making this area accessible for doing that kind of wetlands restoration activity on that site. So, that is something that we'll be going into in further detail in our formal written comments, but I wanted to raise that issue as an oral comment right now for you to consider. And that final point on that is that my understanding, according —— based on the settlement of litigation between the City and the Sierra Club and the Audubon Society with regard to the Environmental Impact Report for the site, that is now the preferred alternative use for —— that wetlands is now the preferred alternative use consistent with the redevelopment plan for this particular site.	During preparation of the FS Report for Parcel E (ERRG, 2012), the Navy previously responded to Arc Ecology comments regarding the compatibility of the CERCLA remedial alternatives with the CCSF's future redevelopment plans (as guided by the 2010 HPNS Redevelopment Plan [SFRA, 2010b]). The previous responses are briefly summarized in the following paragraphs. The CCSF's EIR (SFRA, 2010a) was prepared pursuant to CEQA, and was the subject of litigation between the CCSF and Sierra Club/Audubon Society. The court-approved settlement agreement between the CCSF and Sierra Club/Audubon Society identified design concepts (including constructed wetlands for stormwater management) for portions of Parcel E that were to be implemented by the CCSF's developer (i.e., Lennar Corporation). CEQA does not apply to the Navy's cleanup decisions under CERCLA, and there is no legal requirement for the Navy to conform to CEQA. Nonetheless, the Navy reviewed the CCSF's EIR and determined that the remedial alternatives presented in the FS Report (which formed the basis of the selected remedy in this ROD) are compatible with the future reuses identified in the 2010 HPNS Redevelopment Plan. The Navy evaluated an appropriate range of shoreline protection technologies and process options in Appendix D of the FS Report. This evaluation concluded that the most viable shoreline protection options for the Parcel E shoreline are armoring (rock revetment) and hybrid stabilization using natural shoreline materials with underlying rock armor. Section 4.2.2.3 of the FS Report identifies a conceptual design for implementing these two options along different sections of the Parcel E shoreline. The conceptual designs presented in the FS Report will be further refined in the RD and will not conflict with CCSF's plans to construct stormwater management systems (including constructed wetlands).

[1] Abbreviations and acronyms are defined at the end of this appendix.

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Spoken Comments by Saul Bloom (Arc Ecology) at the public meeting held on February 28, 2013 *(continued)*

3.	With regard to liquefaction and community acceptance with regard to the ultimate remedy of the site, we would encourage the Navy to —— in its presentation about the engineering for site stabilization and that sort of thing to talk about the impacts of failure in more detail, not just because we are concerned about necessarily failure, but because we think that in co— —— in discussing the impacts of failure with regard to health risk and that sort of thing will help clarify for the community the relative risk of failure for these remedies. People become confused. When people talk about the site fissuring; when people talk about any of these institutional controls failing, often times we don't talk enough about is what is in fact the ramification of such a failure. And in many cases, what we are finding is that the ramifications of these failures are far less than what people are concerned about. As a result, articulating these assessments will be much more helpful to the community in terms of understanding why a particular remedy is selected and how that remedy will be engineered and what —— the ramifications of that remedy's failure. I think those are going to be very, very helpful in terms of translating these decisions back to the community.	The Navy will describe the potential risks associated with liquefaction in the RD and will further evaluate this very important part of the design, including consulting with other technical experts, to make sure that the final cover is built to withstand the appropriate design earthquake and comply with numerous other regulatory requirements. Specifically, the Navy will perform, as part of the RD, a comprehensive static and seismic slope stability evaluation for the covers at Parcel E to ensure that the proposed design can, consistent with the requirements of Title 22 Cal. Code Regs. § 66264.310(a)(5), accommodate the inertial forces generated by the maximum credible earthquake while maintaining the integrity of the cover system. Also, in accordance with the requirements of Title 22 Cal. Code Regs. § 66264.310(b)(1) and (b)(5), the Navy will maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events throughout the post-closure period (which will extend for as long as necessary to protect human health and the environment).

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Spoken Comments by Saul Bloom (Arc Ecology) at the public meeting held on February 28, 2013 *(continued)*

4.	I would be remiss if I did not mention Proposition P. Again, my recommendation to the Navy with regard —— and to the regulators with regard to the discussion of Proposition P is to acknowledge Proposition P for what it is, which is the community's concern about the quality of the cleanup at the site. And in terms of presentation of why specific remedies and health risks are selected, I would highly recommend that the discussion take place in light of Prop P as a reference point getting what the difficulties are, meeting the criteria of what the relative benefits would be. That way, again, as with the liquefaction question, the community would be better able to understand why a particular remedial decision is selected versus the sense that most people get, which is that Prop P is just simply not a topic for discussion among the regulators and the Navy, which I don't believe is in fact the case. I understand that everybody is trying hard to figure out how to address the community's selectio— —— cleanup criterion. And I think the best way to do that, as a friendly suggestion, would be to talk about it effect —— positively and say: It's a recognized concern of the community. Here's why we are doing what we are doing relative to that. And I think that will go a long way to address people's concerns about the selection of remedies for the site.	As described on page 18 of the Proposed Plan, the community acceptance criterion is one of two modifying criteria and has been evaluated based on comments provided in the course of the CERCLA remedy selection process, including those received on the Proposed Plan, and other community input, including Proposition P. Consistent with the NCP [Title 40 CFR § 300.430(e) and (f)], the Navy's evaluation of the community acceptance criterion is documented in this ROD, which includes the subject responsiveness summary. The Navy notes that several engaged residents who live in close proximity to HPNS have agreed with the preferred alternatives published in the Proposed Plan, and their agreement documents community acceptance. Proposition P was adopted by the CCSF Board of Supervisors in Resolution 634-01 in August 2001. Although Proposition P does express a recommendation from the Hunters Point Bayview community for cleanup to a level allowing unrestricted use of the property, Proposition P also urges the Navy to clean up the shipyard in a manner that does not rely on future owners to maintain barriers to protect the public from exposure unless other remedies are technically infeasible. The Navy, in its FS Report that was concurred upon by the other Federal Facility Agreement signatories, has determined that the selected remedies are the most feasible and effective. The Navy also notes that Proposition P is a local governmental resolution and is not a federal or state statute or promulgated regulation. Therefore, Proposition P is not a CERCLA federal or state ARAR for purposes of CERCLA remedy selection in Parcel E.

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Spoken Comments by Raymond Tompkins at the public meeting held on February 28, 2013

Comment No.	Comment	Response
1.	My concern on that in terms of the comment is that, as I've stated in the letter previously when we reviewed E-2 and to the regulators as well for consideration in that matter, that I believe the presumptive remedy is incorrect being utilized here for the remediation work on this particular site of "E." Given the definition and the supporting evidence that I looked at and reviewed, I do not — for the volume, according to RASO and Dr. Lowmax [sic], Laurie Lowmax, who gave a report to the RAB in that her projection of the total volume of soil what was impacted at the E-2 site that it was 23 acres; in some areas it goes to 36 feet deep, and the soil volume is 20 percent of the total volume. I do not see that as municipal waste and that the remedy is inappropriate being used there. I don't see radiation coming out of people's sinks. I think also for consideration on this —— on this issue of presumptive remedy, given the type of radiation from the radium dials —— and I'm an old baby boomer, and they used to make kids watches with the glow stuff on it and that as a child, yes, it crumbled in my hand. It came off real quick, and that we know the second product is radon gas. Great radon gas as being a gas means that it's mobile. The possibility of this, especially with land use and rise being in the area, this could migrate. And then the third product is polonium, which has a life span —— half— life span of 1,600 years being radioactive. That's a long time for the government to be dealing with that. Again, I do not feel that this — and also under the section that talked about being close to tides — thank you — that given all these variables and limitations, that we're scoting —— scooting very close to the edge in terms of what the law and it's up to interpretation. I think for human safety, a more rigid and vigorous approach should be used in the analysis and approach in terms of solving this problem.	The Navy wishes to clarify that it has not relied upon the containment presumption in developing or evaluating the remedial alternatives for Parcel E. Further, the Navy wishes to clarify that Parcel E is distinct from the adjoining Parcel E-2. Parcel E is one of six parcels (Parcels A through F) originally designated for environmental restoration. In September 2004, the Navy divided Parcel E into two parcels (Parcels E and E-2) to facilitate closure of the Parcel E-2 Landfill and its adjacent areas. Parcel E-2 was the subject of a separate evaluation process, performed in accordance with CERCLA[2] and the NCP, that culminated with a signed ROD in November 2012. This ROD addresses Parcel E and is unrelated to the Parcel E-2 Landfill referred to in this comment.

[2] Abbreviations and acronyms are defined at the end of this appendix.

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Spoken Comments by Raymond Tompkins at the public meeting held on February 28, 2013

2.	I have to concur with Mr. Bloom's statement 100 percent. As I was talking to — and then I was told I can't discuss that. But in this point, confirmation, confirmation, confirmation. My criticism was: In the presenting of this evening, there was a lot of assumptions without confirmation, in my view. And that in the future studies for those holes, those — in 2000 — no — 1996, I believe, in '93 when those bores were done, I would like to see confirmation for a couple of reasons. Synergistic effect. After the fire, what other harmful products can be possibility in that how is that brought up in your plan to address that and to then put the limitation? Because one of the issues when — as Mr. Bloom just talked about, when the systems or whatever we create —— we're human beings. There's always a possibility of failure. Then what are the protections safeguard? And would the Navy pay for damages from this failure of the site to the community as it affects their impact in health or property under, for example, a serious earthquake? I haven't heard or — in our discussions or presented publicly how will this hold up under an earthquake? Since Japan had a 9, the earth is changing. We've had historically a 8.2. We had the echoing effect of the Cypress Freeway, although it was a 7 because of the rever— —— re— —— I'm not a geologist, but the wavelength being not —— what do they call it? —— increase because of the bouncing to and forth. This property is susceptible to this under certain conditions. How is that going to be addressed, and how are the safeguards going to be placed over there? I haven't seen it or any of the public presentations. You may have it on record, but we haven't heard about it, since it's no longer a RAB or technically to talk about it. Could you please in future discuss that to the public and the Navy's responsibility and liability of these. Unfortunately, the times we live in drastic situations, and how would that be respond that would hold down confusion under serious situation?	As stated in the response to comment 3 from Mr. Bloom, the Navy will perform, as part of the RD, a comprehensive static and seismic slope stability evaluation for the covers at Parcel E to ensure that the proposed design can, consistent with the requirements of Title 22 Cal. Code Regs. § 66264.310(a)(5), accommodate the inertial forces generated by the maximum credible earthquake while maintaining the integrity of the cover system. Also, in accordance with the requirements of Title 22 Cal. Code Regs. § 66264.310(b)(1) and (b)(5), the Navy will maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events throughout the post-closure period (which will extend for as long as necessary to protect human health and the environment).

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Spoken Comments by John Njoroge at the public meeting held on February 28, 2013

Comment No.	Comment	Response
1.	Hi. I'm intending to make some comments about CEQA and the environmental impact of this project as well as the impact it has on other people here in the Bay Area who are churchgoers and people struggling in this community basically. From James, Chapter 5: Look here, you rich men, now is the time to cry and groan with anguished grief because of all the terrible troubles ahead of you. Your wealth is even now rotting away, and your fine clothes are becoming mere moth-eaten rags. The value of your gold and silver is dropping fast, yet it will stand as evidence against you, and eat your flesh like fire. That is what you have stored up for yourselves to receive on that coming day of judgment. For listen! Hear the cries of the field workers whom you have cheated of their pay. Their cries have reached the ears of the Lord of Hosts. You have spent your years here on earth having fun, satisfying your every whim, and now your fat hearts are ready for the slaughter. You have condemned and killed good men who had no power to defend themselves against you. Now as for you, dear brothers who are waiting for the Lord's return, be patient, like a farmer who waits until the autumn for his precious harvest to ripen. Yes, be patient. And take courage, for the coming of the Lord is near. Don't grumble about each other, brothers. You are yourselves above criticism [sic]. For see! The great Judge is coming. He is almost here (let Him do whatever criticizing must be done).	The Navy wishes to clarify that the cleanup decision being made for Parcel E is following a process established by CERCLA[3] and the NCP. CEQA does not apply to the Navy's cleanup decisions under CERCLA, and there is no legal requirement for the Navy to conform to CEQA. The Navy has worked with EPA, DTSC, and the Water Board to perform the environmental cleanup work at HPNS in a manner that achieves the environmental justice goals (consistent with Executive Order 12898) of fully protective cleanup actions, fair and equal treatment, and meaningful involvement for all people in the Bayview-Hunters Point community. Our efforts to satisfy these goals include: ▪ Substantial regulatory review and oversight of all Navy cleanup activities. The EPA, DTSC, Water Board, CCSF, California Department of Public Health, Bay Area Air Quality Management District, and San Francisco Bay Conservation and Development Commission all have dedicated significant additional staff to HPNS to ensure that the Navy's cleanup work is performed in a way that is protective of the Bayview-Hunters Point community and complies with federal and state laws and regulations. ▪ Substantial financial commitment from the Navy to HPNS cleanup. The Navy has spent approximately $716 million over the past 20 years on the HPNS cleanup program, and these expenditures have made HPNS one of the nation's largest BRAC cleanup programs. The Navy's cleanup efforts to date have successfully removed, treated, or contained a significant volume of contamination that would otherwise pose an unacceptable risk to site workers and future occupants. ▪ Meaningful community engagement under the Navy's Updated CIP. The Navy updated their CIP in 2011 (and will update the CIP again in summer 2013) to present the communication and community involvement program activities that were designed to meet the specific needs and desires of the HPNS community (Navy, 2011).

[3] Abbreviations and acronyms are defined at the end of this appendix.

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Spoken Comments by John Njoroge at the public meeting held on February 28, 2013 *(continued)*

Comment No.	Comment	Response
1. *(cont.)*	*(see above)*	▪ Employment. The Navy works closely with their existing contractors to emphasize the importance of hiring community members to assist in the cleanup program, and works with interested stakeholders (such as the CCSF) to promote job training programs. These efforts have proven successful based on recent estimates—from 2009 to 2011 over 1,000 community members have been employed under Navy contracts (on either full-time, part-time, or temporary basis) to assist in the cleanup program. In addition, the Navy and their contractors have identified a large network of local businesses to assist in the cleanup program, such as those providing document production services, supplying building materials and consumables (drinking water and ice), renting heavy equipment, and transporting soil and rock. These efforts have proven successful based on recent estimates of over $11 million worth of goods and services from local businesses. ▪ Commitment to protective cleanup actions. Most importantly, the Navy, EPA, and the State of California regulatory agencies are committed to fully protective cleanup actions at Parcel E and throughout HPNS. The selected remedies for Parcel E will remove significant amounts of contaminants and safely contain the remaining material, and will prevent unacceptable exposure to humans (both future site users and the surrounding community) and wildlife.

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Written Comments by Andrea Ibarra-Tacdol received on March 12, 2013 via email

Comment No.	Comment	Response
1.	My name is Andrea Tacdol. I am a mother of two living on Van Dyke Avenue in the Bayview, less than a mile from Parcels E and UC-3 of the Hunters Point Naval Shipyard. One of my biggest concerns is that my family already lives beside an industrial zone where trucks are coming and going on our residential street. Residents of our community and neighborhood are feeling the impacts of the air pollution and excess noise. I believe that the Proposed Plan for clean-up for all parcels must include a requirement that trucks coming and going to the Naval Shipyard do NOT go through residential streets. Not only do the trucks inundate our community with even more diesel pollution that is a major cause of asthma and linked to cancer, but the trucks will also be carrying toxic waste. As you remove and dispose of contaminated soil, remove the oil source at the Former Oily Waste Ponds, remove radiologically contaminated soil, please assure us that the trucks are safely carrying the materials out of our community without chance of spillage and avoiding residential streets. The shipyard must have an agreement with the trucking companies to utilize the SF MTA's advised truck routes. There should be a community hotline to call when we see large trucks passing through our neighborhood and the city should find a way to enforce these rules and address violations quickly. Ultimately, we'd like to see the city move beyond having these truck routes as only advisory.	The Navy and their contractors have established strict protocols for all offsite hauling from HPNS cleanup activities. These protocols have been implemented on numerous past cleanup actions at HPNS and serve to minimize the impact of offsite hauling on the local community. Similar protocols would be implemented for the final cleanup at Parcel E. The procedures for offsite hauling, which are detailed in plans that are subject to regulatory agency review and approval, are summarized below. **Dust Control:** Dust control is a top priority on all HPNS cleanup projects. All trucks are covered (tarped) and their exterior areas (most notably the fenders and tires) are cleaned prior to leaving the cleanup site. While driving on paved roads within HPNS property, all trucks adhere to a speed limit of 15 miles per hour. In addition, water is applied to the onsite roads during hauling operations. These onsite actions serve to minimize dust emissions once the trucks leave HPNS property. **Additional Controls for Contaminated Waste:** All contaminated material is properly characterized prior to offsite disposal, and all offsite disposal is performed in accordance with pertinent federal and state requirements. For example, the U.S. Department of Transportation Hazardous Material Transportation regulations require the proper packaging, labeling, and tracking of hazardous wastes while being transported to a licensed disposal facility. **Truck Hauling Route:** The Navy has a qualification process for all truck drivers to ensure that they are properly licensed, and that they fully understand and will adhere to the HPNS protocols for offsite hauling. This qualification process includes a requirement to follow a prescribed hauling route from the HPNS main gate to either Highway 101 or Interstate 280: ▪ Trucks exit the HPNS main gate and turn right on Innes Avenue. ▪ Trucks bear right at the fenced vacant lot as Innes Avenue becomes Hunters Point Boulevard (which again changes to Evans Avenue at the former Pacific Gas & Electric power plant). ▪ Trucks follow Evans Avenue across Third Street to Cesar Chavez. The qualification process, which would be implemented for the final cleanup at Parcel E, includes obtaining each truck driver's signature acknowledging their understanding and acceptance of all protocols for offsite hauling.

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Written Comments by Christopher Mooney received on March 14, 2013 via e-mail

Comment No.	Comment	Response
1.	I write in support of the Navy's proposed plan for cleanup of HPNS Parcels E and UC-3. The February 2013 written proposal provides detailed explanations of cleanup alternatives and adequately considers the cost-to-benefit impacts of each alternative. I agree with the Navy's proposed solutions and hope the cleanup proceeds expeditiously.	Thank you for your comment.

Written Comments by Philip Ragozziano received on March 18, 2013 via mail

Comment No.	Comment	Response
1.	After having read and considered the alternatives, I support the conclusion on page 18 of the pamphlet "Hunters Point Naval Shipyard – Parcels E and UC-3." I have been a resident of the neighborhood outside the shipyard for more than twenty years, have had the opportunity on occasion to tour the shipyard, and thought no clean-up would ever occur. I would rather see the remediation, even if not to the ultimate degree, than nothing done. So please move on with the process right away. Do what's most expedient and will both clean and contain the toxic elements and which can be paid for. Thanks for the opportunity to be heard. Keep me informed with your mailings.	Thank you for your comment.

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

Written Comments by Jaron Browne (POWER[4]) and Marie Harrison (Greenaction) received on April 1, 2013 via e-mail

Comment No.	Comment	Response
1.	POWER and Greenaction are submitting the following comments on the Proposed Plan for Parcels E and UC3, with support and consultation from environmental scientist Wilma Subra. There are two core areas of concern where we differ with the Navy's recommendations in the Proposed Plan: • First, in relation to remediation of residual radiological contamination in the proposed plan, we strongly urge the Navy to use the 3-foot thick soil cover that was proposed in remedy R-3, rather than the 2-foot soil cover. • Second, in relation to the former oily waste ponds, we strongly urge the Navy to pursue Alternative O-6, because of how much information is still needed to understand the level of contamination. Alternative O-6 is the most comprehensive remedy for minimizing risk for the community.	Please refer to the responses to comments 2 and 3 below.
2.	**Residual Radiological Contamination** The preferred alternative R-2 is an appropriate remedy. However, R-3 proposes a 3-foot thick soil cover versus a 2-foot thick soil cover proposed in R-2 and would be more protective. The R-3, 3-foot thick soil cover would provide an added depth of cover material. However, the Navy states the 2-foot thick soil cover is easier to carry out. ***We strongly urge that the Navy adhere to the precautionary principle and apply the 3-foot cover in order to best protect the health of residents.***	As described on pages 17 and 18 of the Proposed Plan (and illustrated in Table 15), Alternatives R-2 and R-3 are both protective of human health and the environment and are equally effective in the long-term. The Navy reached this conclusion based on an evaluation performed in the Radiological Addendum to the FS Report for Parcel E (ERRG and RSRS, 2012). The Navy's evaluation, which was reviewed and accepted by the EPA, DTSC, and Water Board, includes risk modeling that demonstrates the 2-foot-thick soil cover, combined with institutional controls and long-term inspection and maintenance, would prevent unacceptable exposure to people. The information presented in the Proposed Plan, as supported by the Radiological Addendum to the FS Report, demonstrates that the 3-foot-thick cover is not more effective but would be more difficult to carry out. Accordingly, the Navy has selected Alternative R-2 to address residual radiological contamination at Parcel E because it complies with the two threshold criteria, and provides the best balance of tradeoffs with respect to the five balancing criteria specified in the NCP. The Navy's evaluation of the two modifying criteria did not warrant changes to the preferred alternative for residual radiological contamination at Parcel E.

[4] Abbreviations and acronyms are defined at the end of this appendix.

Proposed Plan for Parcel E, Hunters Point Naval Shipyard (HPNS), San Francisco, California

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2. *(cont.)*	*(see above)*	The State of California, through DTSC and the Water Board, and several engaged residents who live in close proximity to HPNS have agreed with the preferred alternative published in the Proposed Plan. The information presented by members of the community that disagree with the preferred alternative does not justify modification of the preferred alternative based upon the "community acceptance" criteria of the NCP. The preferred alternative will remove significant amounts of radiological contamination, safely contain the remaining contamination, and will prevent unacceptable exposure to humans (both future site users and the surrounding community) and wildlife. The Navy wishes to clarify that the precautionary principle, incorporated as a policy statement in Chapter 1 of the San Francisco Environment Code, is a local governmental policy and is not a federal or state statute or promulgated regulation. Therefore, the precautionary principle is not a CERCLA federal or state ARAR for purposes of the CERCLA remedy selection for Parcel E. In addition, the precautionary principle policy statement, as reflected in Chapter 1 of the San Francisco Environment Code, contains no substantive provisions that would pertain to evaluation and selection of a CERCLA remedial action. The Navy believes that the nine NCP evaluation criteria, which were used to evaluate each remedial alternative for Parcel E, adequately capture the elements described in the CCSF's policy statement.
3.	**Former Oily Waste Ponds** The Navy's preferred alternative for the former oily waste ponds consist of O-4. The remedy consists of removal of contaminated oil or in-situ treatment, a soil cover, liner and below ground barrier and active groundwater treatment. This alternative leaves much information to be determined before the actual remedy is selected. Alternative O-5 consists of removal of all contaminated oil above the groundwater. Alternative O-6 consists of the removal of all contaminated oil above and below the groundwater. ***We strongly urge the Navy to pursue Alternative O-6 because it will result in the removal of all the contaminated oil. The contaminated oil in the former oily waste ponds is a principal threat waste in Parcel E.***	As described on page 18 of the Proposed Plan, the Navy's evaluation identified major differences between Alternative O-6 and Alternatives O-2, O-3, and O-4 relative to short-term effectiveness, implementability, and cost. In comparison with Alternatives O-2, O-3, and O-4, Alternative O-6 presents more short-term risks (for example, increased risk of accidents for site workers), would be more difficult to carry out, and would cost more. The ratings for Alternative O-6 were based on several factors, the most significant being the deep excavation (potentially up to 35 feet) required to completely remove the contaminated oil. Alternatives O-2, O-3, and O-4 present fewer short-term risks, would be easier to carry out, and would cost significantly less in comparison with Alternative O-6.

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3. *(cont.)*	*(see above)*	Alternative O-2 would be the easiest and least expensive because it involves only containment, while Alternatives O-3 and O-4 balance ease of implementation and cost because they would involve removing or treating the contaminated oil without major excavations. Accordingly, the Navy has selected Alternative O-4 to address the contaminated oil source at Parcel E because it complies with the two threshold criteria and provides the best balance of tradeoffs with respect to the five balancing criteria specified in the NCP. The Navy's evaluation of the two modifying criteria did not warrant changes to the preferred alternative for residual radiological contamination at Parcel E. The State of California, through DTSC and the Water Board, and several engaged residents who live in close proximity to HPNS have agreed with the preferred alternative published in the Proposed Plan. The information presented by members of the community that disagree with the preferred alternative does not justify modification of the preferred alternative based upon the "community acceptance" criteria of the NCP. The preferred alternative will either remove or treat the contaminated oil source and will safely contain the residual contamination in a manner that prevents unacceptable exposure to humans (both future site users and the surrounding community) and wildlife. Although the complex site conditions at the Former Oily Waste Ponds result in some uncertainty regarding the effectiveness and implementability of certain remediation technologies, the Navy, with the support of EPA, DTSC, and the Water Board, believes that there is adequate information to select a remedy for the contaminated oil source. Further, the Navy believes that Alternative O-4 incorporates a broad range of removal and treatment technologies that could be used in combination to cost-effectively achieve the RAOs. As described on page 26 of the Proposed Plan, the Navy will perform additional studies to select the best combination of technologies to remove or treat the contaminated oil source at the Former Oily Waste Ponds. The Navy has begun developing the approach for these additional studies in consultation with EPA, DTSC, and the Water Board. A field study is planned for later in 2013 and is expected to help refine the cleanup approach at the Former Oily Waste Ponds in support of the RD.

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4.	In review of the soil and shoreline sentiment and groundwater contamination, we are aligned with the preferred alternatives recommended by the Navy. **Soil and Shoreline Sediment** Alternative S-4 is the most robust and protective of the alternatives proposed for contaminants in soil and shoreline sediments. Alternative S-4 is the only alternative that will result in excavation and off site disposal of contaminated soil from Tier 2 and Total Petroleum Hydrocarbon locations. Tier 2 locations contain chemicals at concentrations greater than five times the preliminary remedial goal. Total petroleum hydrocarbons locations exceed the preliminary remedial goal. Alternative S-4 is the only alternative that will address VOC contamination associated with the building 406 TCE plume using soil vapor extraction.	Thank you for your comment.
5.	**Groundwater Contamination** Alternative GW-3 and GW-4 are the most protective alternatives proposed for groundwater contamination. The two alternatives consist of active groundwater treatment for VOC plumes under parcels E and UC-3. Alternative GW-3 consists of either biological nutrients or zero valent iron treatment while alternative GW-4 consists of air sparging for the building 406 TCE plume. The Navy selected GW-3 as the preferred alternative remedy. That alternative, as well as GW-4, will treat the groundwater contaminants appropriately.	Thank you for your comment.
6.	We urge the Navy to reconsider the preferred plans for the residual radiological contamination and select a 3-foot soil cover, and select alterative O-6 the former oily waste ponds based on the need to minimize risk and provide the highest level of protection of the health of residents in the community.	Please refer to the responses to comments 2 and 3 above.